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The Process of the Magnetization of Magnetic Tape

By WALTER GUCKENBURG

Methods for making visible a magnetic recording on tape are described. The effect of permanent fields added to the tape magnetization in different directions is shown to prove that the tape magnetization has a prevailing longitudinal character. The method has been refined to provide a resolving power down to a wavelength of less than 0.4 mil, i.e., the bias frequency at 30 ips tape speed, and an exact azimuth measurement within 1 minute of arc.

AN ACCURATE STUDY of the mechanics of the magnetic recording process is hindered by many difficulties, and achievements in this area have not been wholly satisfactory.[1–5] Chief of these difficulties is the extreme nonlinearity and irreversibility of the relation between the field applied at the recording head and the resulting magnetization in the tape. Advancement of a theory for the recording mechanism hinges on the ability to obtain a quantitative indication of the remanent magnetization induced in the tape and its geometry. Sufficient information cannot be obtained from the use of a playback head because its voltage output provides none of the details of the magnetic geometry. However, it is possible to obtain microscopic observations of the magnetic geometry by making visible the remanent magnetization recorded on the tape under normal conditions.

E. Meyer and Schuller[6] succeeded as early as 1932 in showing a magnetic recording on wire by means of iron powder. Coarseness of the medium permitted only field pictures with blurred contours. An improvement was found by using a suspension of very fine powder of carbonyl iron in oil or glycerin.[7] Even this procedure was not exact enough to show the magnetization with sufficient sharpness for a quantitative interpretation. Details were obscured by powder chains caused by the high permeability of the iron particles (Fig. 1).

Today's magnetic tapes consist generally of a plastic base of cellulose acetate or polyvinylchloride. On this base a magnetically active layer of iron oxide powder in a binding agent is applied. The particles of this powder have a diameter of less than 0.04 mil and constitute about 25–35% of the layer.

Some of these layers can be softened in a suitable solvent. Normally a short dipping in amylacetate will be sufficient. The magnetic forces existing between the particles of a prerecorded tape will cause a deformation of the softened layer which

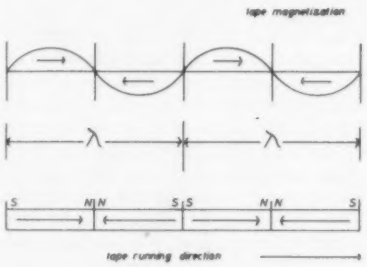

Fig. 2. Direction of the tape magnets supposing a longitudinal magnetization.

Presented on October 7, 1955, at the Society's Convention at Lake Placid, N.Y., by H. C. Wohlrab who read the paper for the author, Walter Guckenburg, Institut für Technische Akustik, Technische Universität Berlin-Charlottenburg, Berlin-Charlottenburg 2, Jebensstrasse 1, Germany.

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(This paper was received on September 27, 1955.)

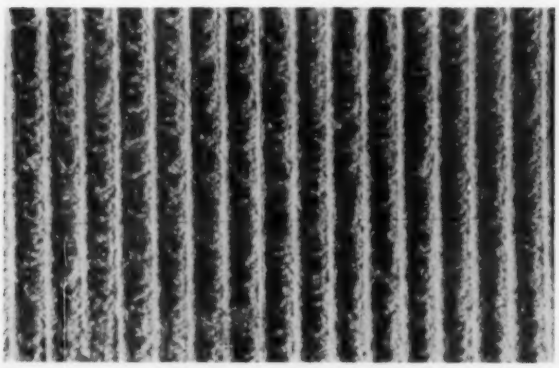

Fig. 1. Magnetic soundtrack visible by carbonyl iron powder. Accumulation of iron powder at the zero points of magnetization. Strip width, λ/2.

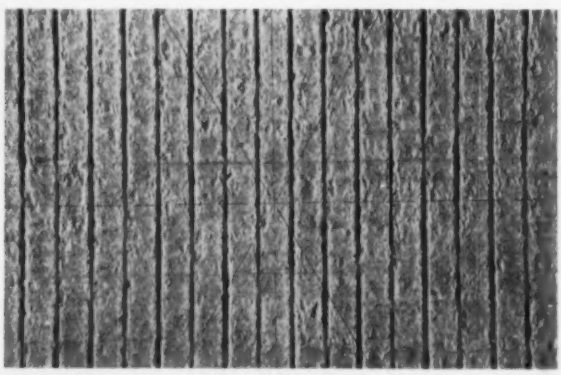

Fig. 3. Magnetic recording visible by complete separation of the softened layer of the zero points of magnetization. Each strip, λ/2.

Fig. 4. Magnetic recording visible by plastic deformation. Lifting the layer at the zero points of magnetization and some tearing of the layer.

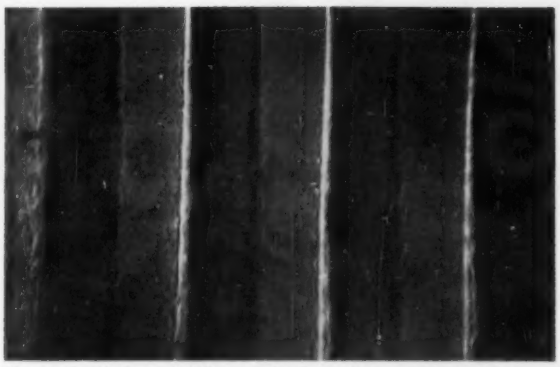

Fig. 5. Roof shaped lifting of the layer in a magnetic field vertical to the tape surface.

can be observed visually. The resulting visible pattern not only gives a much more detailed reproduction of the soundtrack but seems to open a way for considerations about direction and value of remanent induction at the different points of magnetization.

Magnetization Direction

There is still no agreement in the literature[1–5] whether magnetization in the direction of tape travel (longitudinal) or perpendicular to the tape surface (perpendicular) results when recording with a normal ring head. Study of this problem is made possible by this method of rendering the soundtrack visible.

Longitudinal Direction: In the case of longitudinal magnetization two poles of the same polarity adjoin each other on the zero points of each half of a wavelength ($\lambda/2$) of a sinusoidal curve, two north poles on one and two south poles on the next (Fig. 2). The identical poles repel each other, and since the magnetic particles are free to move in the softened layer they tend to separate at the zero points. Thus, a plastic deformation arises which can actually separate the layer completely at the zero points (Fig. 3). In a layer that is less soft the repelling forces are not sufficient to separate the layer completely but merely strong enough to reduce the layer thickness at the zero points (Fig. 4).

The existence of longitudinal magnetization seems to be evident from these photographs. The next step was to photograph and examine these softened $\lambda/2$ strips when subjected to an additional magnetic field of a definite direction and value and to conclude from the reaction of the particles the primary magnetic condition of the tape and the direction and value of the remanent magnetism.

A piece of tape with a sinusoidal recording on it was exposed to a permanent magnetic field in a direction perpendicular to the tape surface. The results obtained were as expected for an assumed longitudinal recording. One side of the $\lambda/2$ strip — e.g. the north pole end — was lifted up like a roof, the other end remaining on the surface (Fig. 5). A field induction of 10–20 oersted of the additive field was sufficient. In a softer layer, particularly at shorter wavelengths, one of the zero points can be completely eliminated and the $\lambda/2$ strips become λ strips (Fig. 6). As the polarity of the permanent field is reversed the deformations at north and south zero points are interchanged and this effect can be repeated several times on the same $\lambda/2$ strip.

The effect of exposure to a permanent field in the direction of the longitudinal axis of the tape is shown in Fig. 7. The magnetic particles polarized in the same direction as the permanent field are not affected at all. The random lines in the half-wavelength region in which the particles are polarized in the opposite direction indicate a turbulent movement. Figure 4 shows that without a permanent field the recorded magnetization was sufficient to move the particles in the layer. The oppositely polarized particles are in an unstable condition tending to move in the direction of the permanent field and this causes the random lines or rippled effect in the photographs. A perpendicular magnetization component in the recording would increase this effect but the ripple in each second $\lambda/2$ strip cannot be considered as a proof of a perpendicular component.

A very impressive proof of longitudinal magnetization is shown by exposure to a magnetic field parallel to the recorded waves (across the width of the tape). This field pushes one end of the $\lambda/2$ strip assuming longitudinal recording and pulls the other, forming wedge-shaped figures in the layer plane (Fig. 8). This effect is still more impressive in Fig. 9, which shows a nonsymmetrical recording of two tracks. These tracks, having dif-

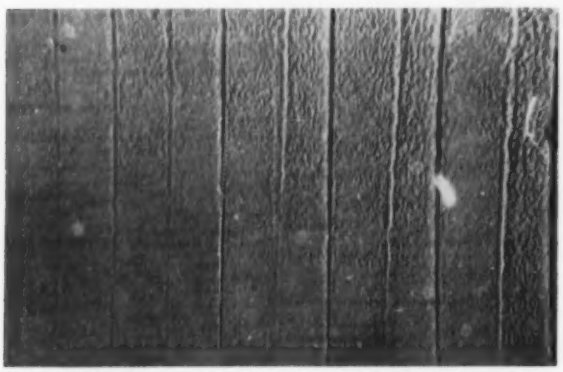

Fig. 6. Extinguishing of the $\lambda/2$ strips and forming of λ strips in a magnetic field vertical to the tape surface.

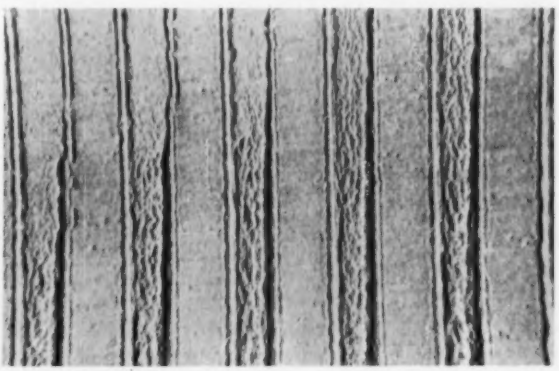

Fig. 7. Plastic deformation of the $\lambda/2$ strips in a field in tape running direction ($\lambda/2$ – 10 mil).

Fig. 8. Plastic deformation of a recorded symmetrical frequency in a field parallel to the wavefront.

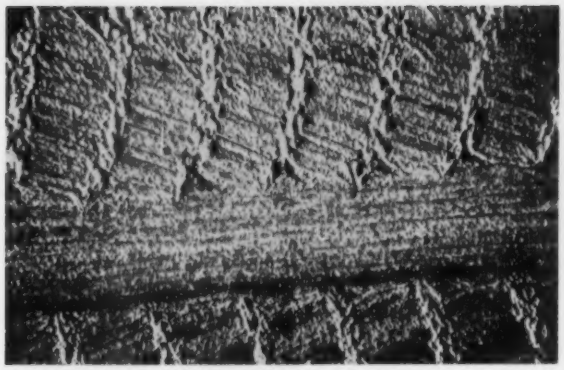

Fig. 9. Plastic deformation of a double-track recording with unsymmetrical waveform by a field parallel to the wavefront.

ferent widths, are exposed to such different torque moments that the wavefront itself is deformed in a quite remarkable way.

The described deformation of the $\lambda/2$ strips can be observed in better detail if the layer is not merely softened by a brief dipping, but if it remains in the solvent while observed. It can then be seen that the $\lambda/2$ strips are completely detached from the base after separating at the zero points. When exposed to a field perpendicular to the tape surface the $\lambda/2$ strips are directed perpendicular to the tape surface (Fig. 10c). Upon removal of the field the strips do not fall back into their original position but form a chain of poles all in the same direction (Fig. 10d). The visible picture is similar to Fig. 3, although this does not show that all strips now have the same direction. When this piece of tape is again exposed to the same field the whole chain is lifted (Fig. 10e) and not the strips separately, because they are held together by the inner field lines.

Tape-running Direction: Exposure to a field in the tape-running direction causes only the oppositely polarized strips to be lifted (Fig. 10f), and when the field is removed they fall down again but not into their former position. Under the influence of the neighbor strips they fall upon them in the direction north to south and south to north (Fig. 10g). As a result of this phenomenon the base is visible in the space formerly covered by these strips.

All the above described effects permit the conclusion that the longitudinal magnetization component is at least prevalent. Further experiments will attempt to determine how much of the perpendicular component is obscured by the longitudinal one. A quantitative measurement of the remanent magnetization, e.g. by comparing visible recordings, is the subject of present experiments.

Exposure of the tape to an additional field increases the resolving power of the process. Without a field the limit is at about 1 mil. Under the influence of the field, recordings of less than 0.4-mil wavelength corresponding to 19,000 cycles/sec at a tape speed of 7.5 in./sec or 76,000 cycles/sec at 30 in./sec may be examined (Fig. 11). This frequency is almost the same as the bias frequency. Before long, it should be possible to analyze tracks of a wavelength of about 0.1 mil, corresponding to the signals of a magnetic video recording.

Other experiments investigating the problem of the biasing mechanism are now in progress. Figure 12 shows an initial test using 500 cycles/sec and a bias frequency of 40 kc/sec at a tape speed of 30 in./sec. Some experiments have already given promising indications as to what kind of combination frequencies are created in the tape and which of these occur in later parts of the transmission chain.

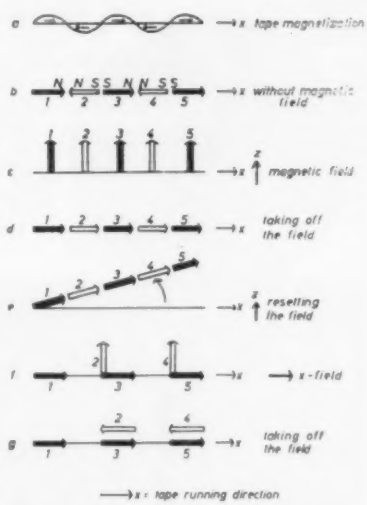

Fig. 10. Movement of the $\lambda/2$ strips by means of a magnetic field.

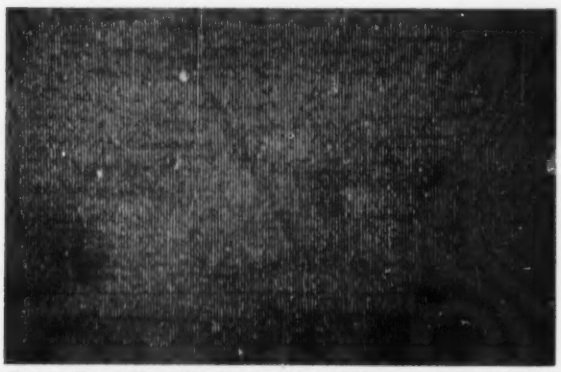

Fig. 11. Recording of 10 kc/sec at 7.5-in./sec tape speed visible by plastic deformation.

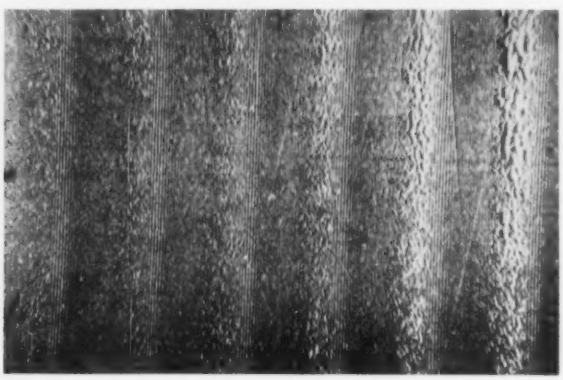

Fig. 12. Recording of audio and bias frequency.

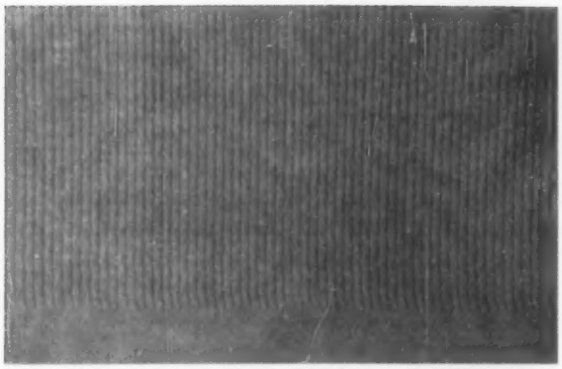

Fig. 13. Showing a bad magnetic head by plastic deformation. Each second zero point extinguished by a magnetic field vertical to the tape surface. $\lambda = 2.5$ mil.

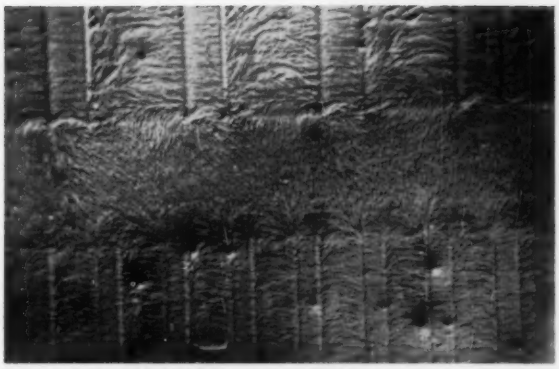

Fig. 14. Magnetic field lines of a double-track recording ($\lambda =$ 20 mil and 40 mil) visible by a suspension of magnetite powder in a field parallel to the wave fronts.

Evaluation of Method

The practical application of the described method is briefly discussed in the following paragraphs:

The sharpness of the wave pictures shows up irregularities of the gap edge with an accuracy of about 0.04 mil (Fig. 13).

The azimuth angles of the recording head gap can be measured. The inaccuracy of this method is less than ± 1 minute of arc. Thus, the production of azimuth test films has been facilitated, the usual accuracy of the azimuth being ± 3 minutes of arc. Measuring the azimuth angle on different points of the film can reveal lateral movements of the film.

By measuring the recorded wavelength the absolute speed and speed variation can be measured within a limit of $\pm 0.1\%$.

The sensitivity of the method allows measurements of a soundtrack level of from 3% to 100% modulation.

Another method of making the soundtrack visible is by using ordinary magnetic powder. One condition for a successful experiment is to apply the particles suspended in an oily liquid to the layer in the presence of a magnetic field. This field transforms the nonmagnetized oxide particles into very fine needle-shaped permanent magnets of a length of 0.04 mil and a thickness of 0.004 mil. Upon removal of the field these magnets are directed into the field line directions, revealing the field structure beyond the edges of the tracks. In Fig. 14 the field was parallel to the recorded wavefronts.

This method could be used to show frequencies of 16 kc/sec at 7.5 in./sec tape speed, corresponding to a wavelength of 0.5 mil.

Figure 15 shows the magnetic picture of an erase head with d-c bias. The gap, with a homogeneous field (16-mil gap width) can be seen as well as the laminated mu-metal and the field lines outside the gap.

Conclusion

In conclusion, it may be said that making visible the remanent magnetization of a normal recording will contribute to a better assessment of the performance of the magnetic recording mechanism.

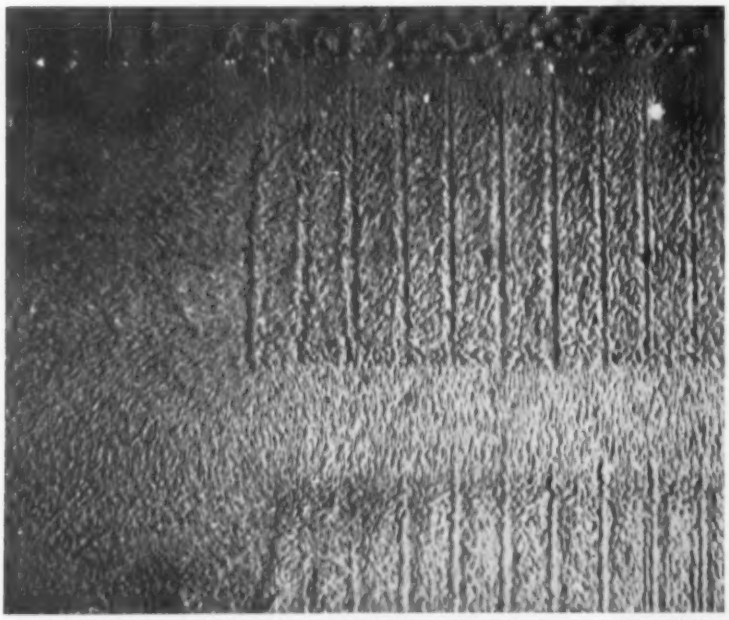

Fig. 15. Field lines of an erase head biased by d-c (16-mil gap width) visible by magnetite powder and a field vertical to the tape surface.

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ABC's of Color Television

By J. M. BARSTOW

TELEVISION programs in color are now being produced regularly by major broadcasting companies, and the corresponding signals are being transmitted over both the local and intercity facilities of the Bell System to color TV transmitters. Although much publicity has been given to the advent of this rather astonishing new development, most of the articles have been either highly technical or intended for the newspapers. They have not provided an understanding of the system for intelligent engineers who are not able to devote sufficient time to the subject to master the more obscure technical details. This article is intended to fill a need felt in many quarters to answer a number of questions which have arisen concerning the generation of the signals and the manner in which they are used to produce a color picture.

It will be assumed that the reader has some knowledge of how a black-and-white TV picture signal is generated and displayed; i.e., the picture is "painted" on the TV tube by the modulated intensity of a spot which is swept repeatedly across the face of the tube from left to right, each sweep taking about 1/15,750 sec, the spot descending gradually from top to bottom of the tube in about 1/60 of a second. This cycle of events occurs over and over again, giving rise to the illusion of continuous motion in any televised scene.

With this background in mind, curious engineers generally have several simple questions in mind when they are told that by a modified, but compatible, system, a color picture can be painted on the tube face. Some of these questions are: (1) how does the system work in simple terms? (2) how is color (hue) produced on the picture tube of a color receiver? (3) how can color TV signals and monochrome TV signals be "compatible"; i.e., what does a monochrome receiver do with the color information signals (which it does not need and cannot use), and how can a color receiver do without color information? In an attempt to answer these questions in

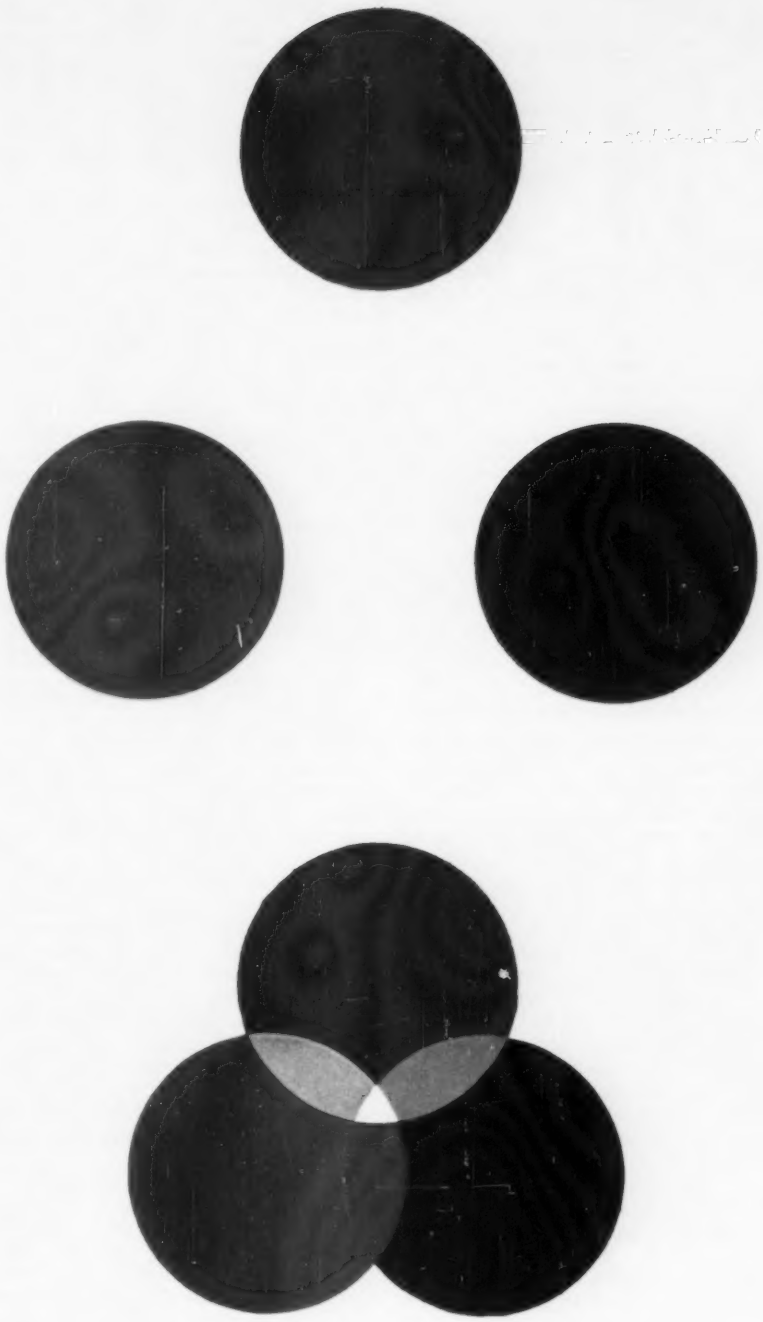
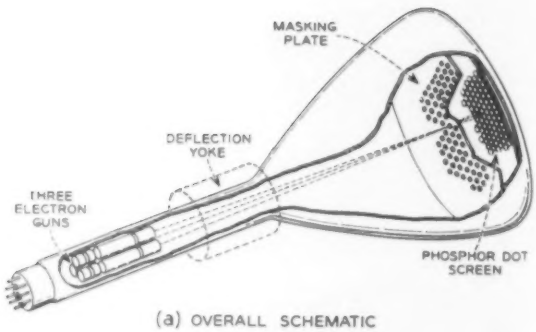
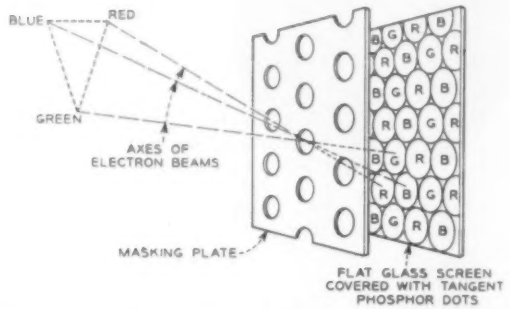


Fig. 1. Primary colors of the additive system: above, shown separately; below, shown partially merged.

This article by J. M. Barstow, Bell Telephone Laboratories, 463 West St., New York 14, is reprinted here through the cooperation of E. K. Gannett, Managing Editor, The Institute of Radio Engineers. It first appeared as "Color TV — How It Works," in the Sept. 1955 IRE Student Quarterly, pp. 11–16.



(a) OVERALL SCHEMATIC



(b) ENLARGED SECTION SHOWING GEOMETRICAL RELATIONS

Fig. 2. Structure of tri-colored television tube.
(Courtesy of RCA.)

easily understandable terms, a description will be given in the following paragraphs and associated figures of the general plan employed, without going into details as to how the plan is carried out.

Colorimetry and the Color Picture Tube

A few rudimentary principles of colorimetry must first be understood; i.e., those having to do with the reaction of human vision to lights of differing color. The necessary principles may best be understood by describing an experiment with colored lights. Suppose, for example, in a darkened room, a white reflecting surface is illuminated in three different spots with light from three different projection lanterns. In the path of the light from one lantern, a filter will be placed which will allow green light to pass through, but no other color. Similarly, in the paths of the beams from the other lanterns, red and blue filters will be placed respectively, so that to an observer with good color vision, the spots will appear to be green, red and blue. Now suppose the projection lanterns are oriented so that the three spots partially merge. The area on which all three lights fall simultaneously will appear white. The area on which green and red light falls will appear yellow; the area on which red and blue light falls will appear as lavender or magenta; and the area on which the blue and green light falls will appear blue-green or cyan. These results are shown on Fig. 1 and the results of the experiment illustrate the additive properties of colors (not to be confused with the subtractive properties of color when different color pigments are mixed).

The additive properties of colored lights are employed in color television. When the eye can see separate areas (i.e., areas large enough to be resolved by human vision) illuminated by different colored lights, it will recognize the different colors, but when the colors merge, or the areas become so small and so close together that the eye sees them as if they were in the same place, the individual colors no longer are recognized. In the experiment described above, if the dots were each reduced in size to about that of a pinhead, and then so located on the white surface that they did not merge but were tangent to each other, the area which they effectively cover would appear white from a distance of about 15 ft. At a distance of a few inches, the three separate colors would be recognized.

The structure of a color television picture tube is shown in Fig. 2. Phosphor plate of tube is a glass screen covered with about 1,070,000 phosphor dots (21-in. tube), one-third of which will glow green under the influence of a beam of electrons; one-third, red; and one-third, blue. The dots are placed on the phosphor plate of the tube in clusters of three: one green, one red, and one blue, so that there are about 350,000 clusters of three dots each, uniformly distributed over the active area of the tube. The neck of the tube contains three electron guns, the first, for emitting a beam intended for the green glowing dots, the second, for emitting a beam for the red glowing dots, and the third, a beam for the blue glowing dots. Between the electron guns and the phosphor plate, but only about one-half inch from the phosphor, is a masking plate which has 350,000 small holes in it, each hole being placed approximately over the center of a cluster of three phosphor dots. Under the influence of focusing coils and magnets, the three beams from the three guns are made to converge at the masking plate, and hence, they diverge slightly beyond the masking plate. This slight divergence is sufficient so that the beam from the green gun strikes only the green glowing dots and similarly, the beams from the red and blue guns strike only the red and blue glowing dots, respectively. A cluster of three phosphor dots is so small that one dot cannot be resolved from another at distances greater than a few feet. Therefore, at distances of four times picture height or greater, a wide range of colors can be produced (including white) by controlling the magnitudes of the beams from the three guns. The apparent sharpness of the picture is reduced very little. When the beams from the three guns are strong, and correctly proportioned in magnitude, white is produced. If they remain in the same proportions, but are gradually reduced in magnitude to near zero, the white is correspondingly reduced in intensity through shades of gray to black. If the beam from the green gun is strong and the others near zero, the color produced is green (the red and blue glowing dots do not glow). Similarly, any color can be produced that is within the range of colors that can be synthesized from green, red and blue. This range embraces nearly all those seen in nature or employed by human beings for decorative purposes.

As the tube is scanned from left to right and from top to bottom by the three beams in unison, the convergence of the beams at the masking plate is maintained within close limits.

The remaining features of the system are concerned with the production and transmission over one 4.2-mc circuit of the signals applied to the three guns of the picture tube.

Color Signal Generation

Color signals are generated in a manner shown in Fig. 3 below. Three cameras are used effectively with light filters so that the output of one camera is due to the green light obtained from the object being televised, the output of the second, due to red light, and that

of the third, due to blue light. The horizontal and vertical sweep voltages and associated pulses are provided by the camera equipment which converts the light signal to electrical potentials E_{Red}, E_{Green} and E_{Blue}. The gamma unit contains a set of nonlinear amplifiers through which the electrical signals are passed. The unit is used at the early stage of signal generation to anticipate and correct for a characteristic of picture tubes used in receiving sets. The light output of a phosphor in a picture tube is directly proportional to the beam current striking it, but the beam current is proportional to about the 2.2 power of the voltage applied to the picture tube grid. Hence, in the gamma unit, the nonlinear amplifiers whose outputs are proportional to approximately the 1/2.2 power of the inputs, are correct for the opposite kind of nonlinearity in the picture tube. Between the outputs of the gamma unit and the picture tube grids, the system is intended to be linear.

The three outputs of the gamma unit are usually adjusted to be equal when a white area is being televised. They are then fed into a matrix unit which derives three signals: one to be used as a brightness or luminance signal similar in every respect to a monochrome signal, and the other two to be used as color information signals. In Fig. 3, the brightness signal is labeled E'_y, and is formed by adding .59 of the green signal, .3 of the red signal, and .11 of the blue signal. These fractions of the individual color signals are combined because it has been determined subjectively that the three colors contribute to the total brightness of a scene in these proportions. The brightness of a given area in a televised scene corresponds to the "lightness" of the area, or the inverse of the "darkness" of the area, irrespective of "hue."

The two color information signals are formed as indicated on the figure. These signals are going to be used to modulate two single frequencies (color subcarriers) which are identical except for a 90° phase difference. Therefore, the proportions of each color output used are selected so that, if the different hues are considered as located along a circle, as indicated in Fig. 4, their projections on E'_i and E'_Q axes will result in the correct magnitudes of modulating voltages. Before projecting the primary color voltages onto the E'_i (in phase) and E'_Q (quadrature phase) axes, two other magnitude adjustments are made. One governs the relative magnitude of chrominance and luminance signals, and the other adjusts the three primary color magnitudes so that when a white or gray area is televised (corresponding to equal gamma corrected color voltage outputs in each of the three colors), the color voltages projected onto the E'_i and E'_Q axes will sum to zero. Hence, the modulators will have zero output. These two adjustments in the color signal voltage magnitudes produce levels of $E'_G = .593$, $E'_R = .632$, and $E'_B = .447$ before projection on the E'_i and E'_Q axes. When these color voltages are projected onto the E'_i and E'_Q axes, the results are as shown on Fig. 3. It will be noticed in this figure that the coefficients of the color voltages sum algebraically to zero, indicating that when the original gamma corrected output color voltages are equal, both the E'_i and E'_Q modulating voltages reduce to zero. It is obvious from the signs of the coefficients of the color signals emerging from the matrix unit that this unit must contain phase inverters as well as attenuators, amplifiers and mixing circuits.

Figure 4 shows the magnitudes and the angles of both the primary colors, red, blue and green, and the complementary colors, yellow, cyan and magenta. The magnitudes and angles of the complementary colors are the vector resultants of the adjacent primary colors; i.e., yellow .447 at 167° is the vector resultant of red and green; similarly, cyan is the resultant of green and blue, and magenta the resultant of blue and red.

The two modulated subcarrier outputs are combined as indicated in Fig. 3. Since each output consists of an amplitude-modulated color subcarrier, the combination will also be an amplitude-modulated color subcarrier. Since the two components differ in phase by 90°, their vector sum will have an angle which is determined by the relative magnitudes of each component and thus will be phase modulated also. It should be noted that each component output may have reversed phase (i.e., 180° from normal), as when the modulating voltage changes sign from positive to negative. The arrangement, therefore, provides that the color information is contained in an amplitude-modulated subcarrier whose angle, referred to an arbitrary reference, may have any value from 0 to 360°.

The color signal is then combined with the luminance signal as shown schematically in Fig. 3. Since the color subcarrier has been chosen to be an odd multiple of half-line frequency (455×half-line fre-

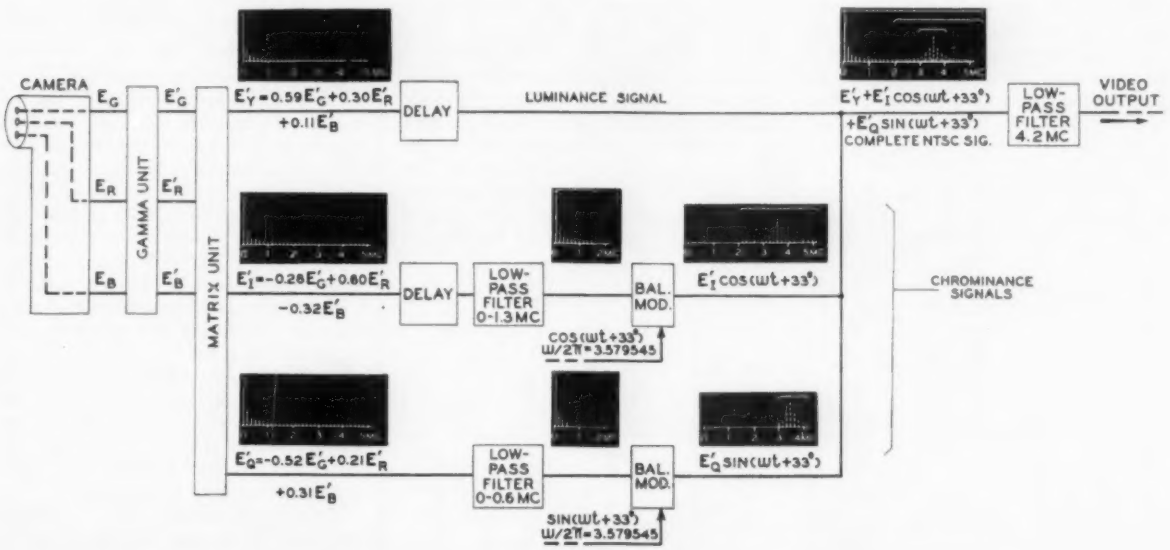


Fig. 3. Schematic of equipment component functions for generating NTSC color video signals.

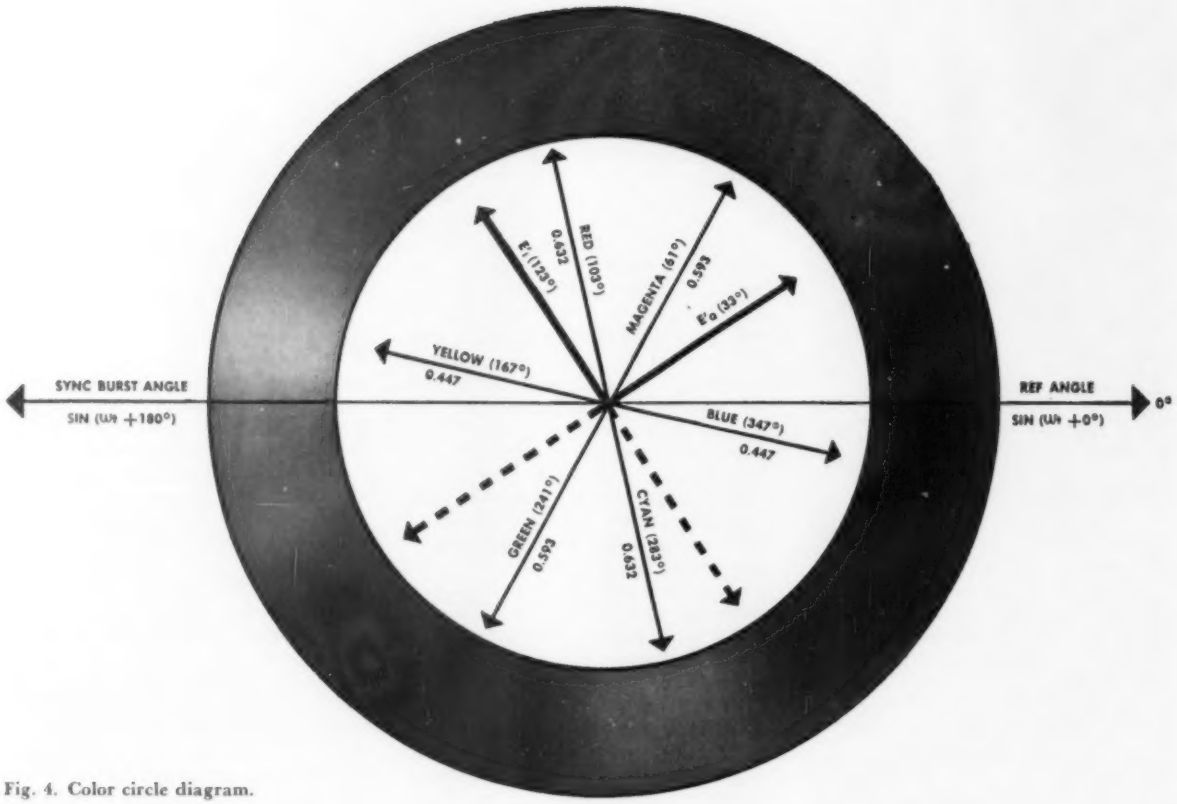


Fig. 4. Color circle diagram.

quency), the color signal interleaves with the luminance signal as shown in the small bandwidth illustration near the line schematically representing the output signal. This is the video signal which is transmitted. A somewhat more detailed illustration is given in Fig. 5. The solid vertical lines indicating frequency components comprise the luminance signal, and the dotted lines, the chrominance signal. Only one-tenth of the number of components are plotted for clarity of illustration. In this signal, the components of the luminance signal are separated by line frequency (approximately 15.75 kc), as are those of the chrominance signal. It should be remembered that the luminance signals are present at all times during the transmission of a picture, although the levels of the higher frequency components vary considerably, depending on picture content. On the other hand, the chrominance components will disappear entirely when black and white objects are being televised.

Figure 6(a) shows a color bar pattern as it would appear on the screen of a color television set and Fig. 6(b) shows the corresponding video signal waveform in one-line interval. The scale at the left of Fig. 6(b) may be considered as a video voltage scale in one-hundredth volt units. The first negative pulse is the line-synchronizing pulse which is used to send the three converging color beams back to the left side of the raster. The next short burst, at a low-voltage level corresponding to black or at least a dark level, is the color subcarrier synchronizing burst, and is used to control the frequency and phase of the demodulating oscillator in the receiver. The phase of this burst is always 180° away from reference phase, as indicated in Fig. 4. The next burst of frequencies corresponds to fully saturated green, having a peak-to-peak amplitude of $2 \times .593 = 1.186$ and an axis level equal to green brightness or .59 (brightness indicated by light dotted lines). The next burst corresponds to saturated yellow and has a peak-to-peak amplitude of twice the resultant of maximum red and green (see Fig. 4), or $2 \times .447 = .894$ with an axis level equal to yellow brightness (green brightness plus red brightness), or $.59 + .30 = .89$. The next burst corresponds to saturated red with an amplitude of $2 \times .632$ or 1.264, with an axis level at red brightness or .30. The other bursts and the corresponding colors can be seen and the amplitudes and levels of axes computed in a like manner. The factor of 2 in all these computations is used to obtain the peak-to-peak magnitudes from zero-to-peak magnitudes commonly used in electrical engineering as an expression for the maximum amplitude of a sinusoidal wave form.

The phases of the different groups of waves correspond to those shown in Fig. 4, although this cannot be well illustrated in the figure.

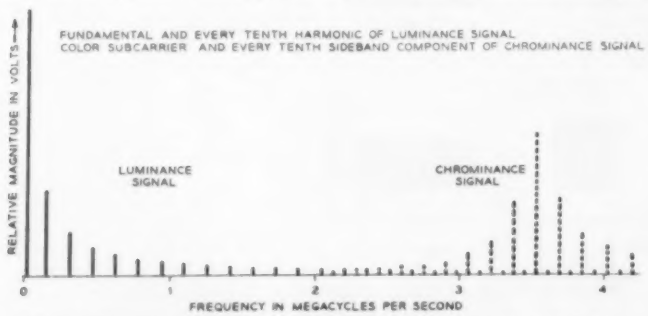


Fig. 5. Frequency composition of typical NTSC color TV signal.

In review of what is shown in Fig. 6, three principles should be stated:

1. Level of zero axis of a group of waves representing a single color represents brightness of the color. [E.g., yellow and cyan have highest and next-highest brightnesses in Fig. 6(b) and are brightest of the six portrayed on color bar pattern, Fig. 6(a)].

2. At any brightness level, the amplitude of a group of waves representing a color corresponds to the saturation of the color. The word "purity" has been applied to this characteristic and it indicates the extent to which the color approaches that of light of a single wavelength. Low purity (amplitude) would indicate dilution with other colors, tending to make the resultant move toward some shade between black and white.

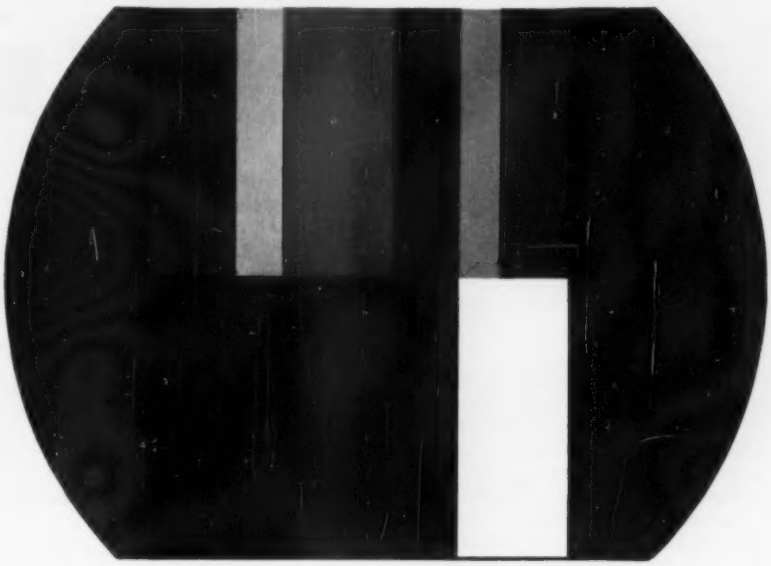
3. The phase of the group of waves representing a single color determines the hue of the color.

Figure 6 also shows the signal corresponding to black-and-white. When the spot formed by the three converging beams passes over the lower half of the image (corresponding to the black-and-white portion of the subject material), the gamma corrected color outputs are equal; they are equal to approximately zero for the left part of the lower half of the picture. They remain equal, but assume high values (unity) for the white area shown at the lower right. The video waveform signal corresponding to this lower picture area is indicated by the heavy solid line at the zero potential level and at the 100 level.

Signal Reception

Once the general scheme for producing the signal is understood, the method of demodulating it to provide signals for each of the three guns in the color tube is rather easily followed. The method is indicated schematically in Fig. 7.

There is no attempt made to separate out the chrominance signal from the luminance signal by toothed, or comb, filters. The complete signal is used for a luminance signal as indicated, although the chrominance information in it is unwanted. This unwanted signal, however, has such a frequency composition as to greatly reduce its visibility in the picture. This is because the error it produces in the picture effectively phases out in the succession of lines and fields by means of which the picture is presented. Specifically, if the chrominance signals produce a brightness error at one spot on the picture, as this spot is traversed by the resultant beam from the three guns, an error of opposite sign will be produced



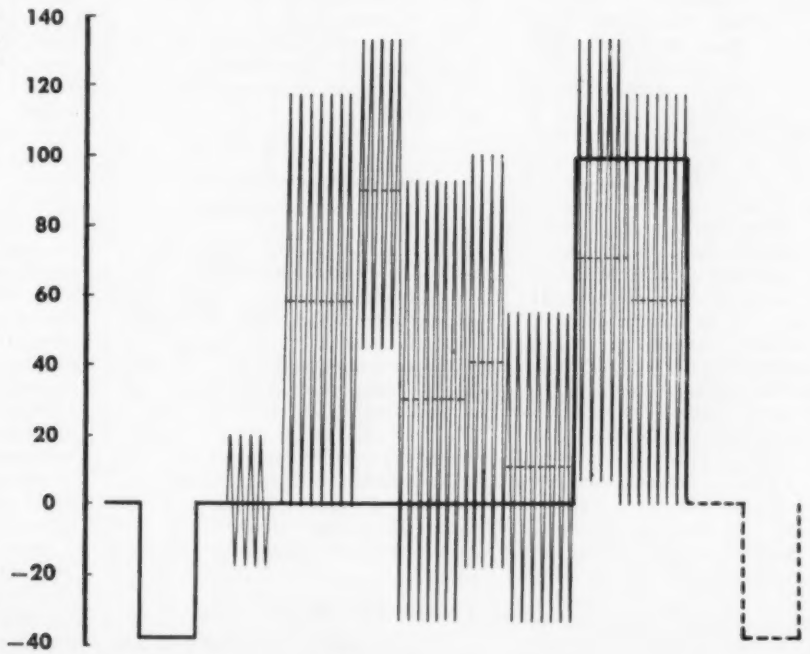


Fig. 6. Color bar pattern and corresponding color video signal: (a) color bar pattern; (b) color video signal.

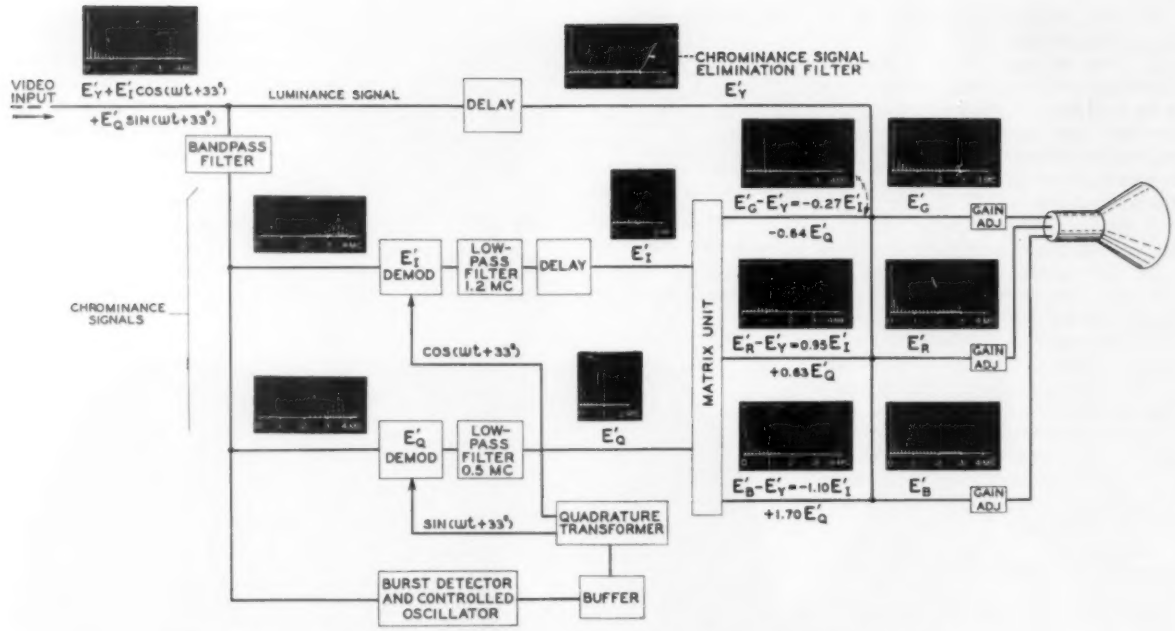


Fig. 7. Schematic of equipment component functions for receiving NTSC Color Video signals.

at this location in the horizontal motion of the spot on the next line in that field. That is, if the error due to chrominance is too bright a spot in the first line referred to above, the corresponding spot will be too dark on the next traverse of the beam across the picture. These errors are therefore close together on the picture; they are of opposite sign and occur rapidly. These three factors tend to reduce their visibility. Also, when the subject material is black-and-white (or any shade of gray in between), the error disappears altogether because the color subcarrier disappears. As a further safeguard against brightness error due to chrominance signal, manufacturers of color sets are using a low-pass filter to cut off the luminance signal at about 3 mc, cutting off also the chrominance signal, which is an error signal so far as luminance is concerned. The philosophy is that a 3-mc luminance signal *without* the chrominance error signal is better than a 4.2-mc luminance signal *with* the chrominance error signal. This is indicated in Fig. 7 by the chrominance signal elimination filter characteristic applied to the luminance signal.

As indicated in Fig. 7, a bandpass filter is used in the chrominance branch to remove the low-frequency luminance signal. The chrominance signals are demodulated with a synchronous demodulator and the E'_I and E'_Q components are derived. The error in the chrominance signal due to the high-frequency luminance signal is small because (1) the error signal components are small; (2) synchronous detection plus low-pass filtering are used so that the high-frequency positive and negative errors are effectively eliminated.

It is more convenient at the receiver to derive the "color difference" signals first from the chrominance signals. This can be done by combining different fractions of the E'_I and E'_Q as follows:

$$E'_G - E'_Y = -0.27E'_I - 0.64E'_Q$$
$$E'_R - E'_Y = 0.95E'_I + 0.63E'_Q$$
$$E'_B - E'_Y = -1.10E'_I + 1.70E'_Q$$

These equations follow directly from the equations shown on Fig. 3.

The luminance signal is then added to each of the three color difference signals, thus forming the three primary color signals.

$$(E'_G - E'_Y) + E'_Y = E'_G$$
$$(E'_R - E'_Y) + E'_Y = E'_R$$
$$(E'_B - E'_Y) + E'_Y = E'_B$$

These three signals correspond exactly (except for the errors discussed above) to the gamma-corrected color signals put out by the camera, and are applied through separate gain-adjusting networks to the three guns of the color tube. The gain adjustments are for the purpose of proportioning the beam currents to produce radiations from the phosphors which will produce white (or shades of gray to black) when equal voltages are applied to inputs of gain-adjusting networks. The manner in which the color tube uses these signals has been explained.

Transmission of the Color Signal

The color signal which must be transmitted has been described here in two ways: (1) amplitude vs. frequency (Fig. 5), and (2) amplitude vs. time (Fig. 6(b)). It will be apparent from Fig. 5 that since the color is carried by a frequency of 3.58 mc and sidebands, it is important that this frequency region be transmitted with high fidelity. Subjective tests indicate that a 1-db change in the response of the circuit at 3.58 mc can be easily detected, and a loss of 3 db in this region, compared to the transmission at low frequencies (luminance transmission) begins to be objectionable. In other words, transmission at 3.58 mc is as important for chrominance as is transmission at low frepuencies (below 1 mc) for luminance. This added requirement for color signal transmission necessitates more exacting maintenance of circuit response.

The second requirement which makes color TV transmission more difficult is the delay requirements. In this case, the delay characteristic of most importance is the differential delay characteristic at the color subcarrier frequency; i.e., variation in delay with the various voltage positions the subcarrier may occupy in transmission, rather than the delay characteristic most frequently referred to in wide-band transmission, which is delay vs. frequency. This latter delay must also be maintained constant over the whole frequency band within rather narrow tolerances.

Figure 6 shows that different colors are transmitted at different potential levels through the transmission systems. For example, the axis of the synchronizing burst is at a zero level in the figure,

while that of the group of waves transmitting the yellow signal is at a level of 0.89. Since, in the receiving set, the hue of the color is determined by the relationship of the phase of the synchronizing burst and that of the group of waves carrying the color information, it is necessary that the relationship between the phases of these groups of waves be preserved with great fidelity from the point of signal generation to the point where the signal is used. In the example cited, if the group of waves carrying the yellow color information is shifted in phase by as much as 5° with respect to the phase of the waves in the synchronizing burst, a change in hue will be noticed in the picture. If the phase of the yellow color-carrying group of waves is advanced, the yellow color in the picture will become slightly greenish; if the phase is retarded, it will move slightly toward the orange (see Fig. 4). Hence, a differential phase requirement is born, which was not given serious consideration before the advent of color TV. It was considered necessary in overall transmission to maintain differential phase shift within about ±5° limits at color subcarrier frequency.

In regard to compatibility, when a monochrome receiver is fed color signals, only the luminance signal is required. Referring to Fig. 7, the circuitry for selecting the high-frequency chrominance components and demodulating them into color difference signals is not present, and the one gun in the monochrome tube is supplied with the luminance signal, plus the interleaved chrominance signal. As was explained above, the frequency composition of the chrominance signal, which is an error signal so far as luminance is concerned, is of such a nature that its visibility is reduced. In a given small area in a picture, plus- and minus-errors will occur in rapid succession and human vision tends to average them out. Hence, it may be said that the signal is so designed that when received by a monochrome receiver, the visibility of the chrominance portion of the signal in the picture area is materially reduced.

When a color receiver is fed a monochrome signal, the outputs of the synchronous demodulators equal zero; the color difference signals are zero; and therefore, the signal supplied to the gain-adjusting network associated with each gun is the same, namely, the E'_y signal. With equal inputs at these points the beams are of the proper relative strength to produce black-and-white.

Conclusion

It is beyond the scope of this article to go into further detail in regard to how the severe requirements of television transmission are met. It will be sufficient to say that in spite of bandwidths about one thousand times as great as those used for single telephone channels, more severe transmission requirements than those used for telephone transmission are necessary for monochrome TV transmission. More severe requirements must be applied for color television signals, primarily due to the necessity for maintaining amplitude responses constant over the whole 4-mc band, and to the differential delay requirement. Steps are being taken to satisfy these needs, and it is expected that in the reasonably near future, regular color transmissions will be achieved with only moderately increased difficulty over that encountered in the past for monochrome transmissions.

Information on the formation of color TV signals was obtained largely from the reports of Panels 12 and 13 of the National Television Systems Committee. A short bibliography of particular articles of interest is given for the benefit of readers who would like to learn more of the details of the NTSC color system.

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Motion-Picture Studio Production Problems

A Roundtable Discussion

Chairman,
NORWOOD L. SIMMONS

Economic, operational and engineering aspects of recent changes in major studio production practices brought about by wide-screen presentations are analyzed. Written remarks for Convention presentation were prepared by Loren L. Ryder, Paramount Pictures Corp., West Coast Studios, 5451 Marathon St., Hollywood 38; and by Earl I. Sponable, Twentieth Century-Fox Film Corp., 444 W. 56 St., New York 19. After these there follows the open discussion, somewhat condensed, which took place at Lake Placid, N. Y., on October 3, 1955.

Economic Aspects of Utilizing New Engineering Developments

By LOREN L. RYDER

THE TECHNICAL men of the industry have done a great job — they have awakened the industry and brought new life to the box office. This has involved the expenditure of large sums of money, to which no one objects as long as the expenditures are profitable.

The problem is, the pendulum is swinging too far. Some people have forgotten that the objective of the motion-picture business is to make money. The product that we manufacture and sell is entertainment. If the cost of this product and its distribution is greater than the return, we lose money regardless of the entertainment value.

In the United States we distribute our pictures through 18,000 to 20,000 theaters, including drive-ins. There are about 100,000 theaters in the world. An expenditure of $100 per theater will cost $10 million worldwide. An expenditure of $1,000 per theater will cost $100 million worldwide.

The U.S. theater profit, as shown in the Quigley *Almanac*, is only about $25 million — call it $30 million. So, if we want to spend our U.S. theater profit for a year, all we have to do is dream up an expenditure that costs each theater an average of $1,250.

In the United States, about 12,000 theaters have installed large screens, frames and masking at a cost of about $20 million. About 5,000 theaters have installed stereophonic sound for an investment of about $20 million and about 10,000 theaters have bought new standard-type lenses, plus anamorphic, for another $15 million. This is $55 million.

If the cost to date is written off immediately, and if it is written off by the theaters, it will be necessary for the theater gross profit, before depreciation, to treble. Actually, the gross revenue for 1953 was $1,193,000,000 and, although the final gross revenue figure for 1954 is not yet available, it has been estimated at between $1,200,000,000 and $1,300,000,000. This is an increase of 1% to possibly 9%; it is a long way from 300%.

If we are more realistic and write off the expenditure in five years, the cost per year is $11 million. The increase in profit resulting from the increase in business might absorb this, but this produces a situation where the theaters are enjoying increased business without an increase in their net profit. This is not good business from a standpoint of theater operation. An increase in business should result in an increase in net profit.

Most theater equipment suppliers have enjoyed good business during the last 18 months. In fact, they have been enjoying all of the profit from theater operation. If this is to continue, there will be no theater profit and in time, there will be no theaters.

As of this date, the theaters have absorbed about all they can on a write-off basis. Looking to the future, each successive innovation should be self-supporting. This is one of the reasons why Paramount has followed a very conservative policy in regard to double-frame projection in VistaVision.

We are trying to determine whether better picture quality will return more money to the theater boxoffice. The present answer is that it will in certain situations. It is increasing the boxoffice in New York, Los Angeles and a few other centers, including Toronto and London. It has not increased the revenue in some territories. If double-frame presentation is to be used, it must increase the revenue enough to pay for the increased cost of the double-frame prints. The same thing will apply to any other system involving large picture images.

In recent months, there has been an increasing demand for standardization of the release procedure. All of the systems that have been proposed either deteriorate the quality or cost more money. We at Paramount favor standardization and we desire compatibility but we feel that too many changes have already been made and that it is time for the industry to stop and study the problem on a long range basis. The next time we ask the theaters to spend money, it should be toward standardization and it should meet the requirements of the future. It should not be an expedient of the moment.

My remarks are not negative in regard to new equipment. We need new equipment with new capabilities — capabilities that make more money. The greatest shortcoming in all motion-picture presentation is in projection. What we need is a completely new projector with new capabilities. Preferably, this projector should handle the complete show without rethreading. It should be completely automatic, including automatic focusing. It should have a 60° pulldown, 3-bladed shutters, guide rails inside the sprocket holes, a steady picture and probably should include water and air cooling.

We are working in a big business, involving the expenditure of much money. If the business at large is to be successful, each phase must be successful and make a profit. Each innovation must be considered on the basis of its cost to each phase of motion pictures. The passing of an expense from one group to another will never solve the basic problem. If money is poorly spent, everyone loses.

We should stop, look and listen. This applies to the equipment manufacturer, the studio engineer and the theater engineer. The engineer has done a great job. His success has made him a part of management and if he is to share the problems of management, each expenditure should be judged on the basis of its profit potential. We should not stop our progress, but progress should include profit.

Why Wide Film?

By EARL I. SPONABLE

WHEN YOUR program committee asked me to take part in this panel discussion on various subjects of interest to the Society, I chose, on the spur of the moment, the general topic of "Why Wide Film?"

It is probably well to remember that in 1953 B.C. (before CinemaScope), a little over two years ago, the motion-picture business was at very low ebb — although technically it was certainly more stable and standardized than it is today. Cinerama, commercialized by people largely outside the motion-picture business, met with such instantaneous success that there was no escaping the indication of the importance of the public response to this "new look" in motion pictures. So conclusive was this indication that we at Twentieth Century-Fox decided to engineer the CinemaScope process as a single projector, wide-screen system that would be applicable to any and all motion-picture theaters. Since the opening of *The Robe* in September 1953, the worldwide acceptance and growth of CinemaScope have proved conclusively the wisdom of our course of action. There are today about 30,000 theaters equipped to show CinemaScope pictures, and all branches of the motion-picture business have prospered as a result.

I am not sure that I need to restrict my observations and comments during this discussion solely to the "why" aspect of the problem, because that can be answered in a very few words. I would answer it by saying: "We want to use wide film, to get better quality motion pictures on the screen." I do not think it is a foregone conclusion that making the film wider anywhere along the line in the motion-picture production process will, of necessity, result in a better motion picture as viewed in the theater; but this is certainly at least one way in which the producer can make it possible for theaters to obtain improved quality.

Looking back over our experiences with CinemaScope, I sometimes wonder just how much picture and sound quality actually mean to some exhibitors because, in spite of all our efforts to give the theaters something to combat the inroads of television, and to bring the public back into the theaters, an annoyingly large percentage of exhibitors have not made the best use of CinemaScope. They have seemingly done everything possible to save a penny or to cut a nickel off the cost of showing CinemaScope — apparently forgetting that only a short time back they were on the verge of going out of business. The comment I hear all too frequently is, "It doesn't bring in a nickel more at the boxoffice." When CinemaScope is properly used, that is not a true statement. There are ample statistics to prove this — but even were this not so, it seems fairly apparent that motion-picture theaters must be kept up to date, even to keep their regular customers from falling away from them. Every other industry learned this lesson much earlier than we did. There is no reason for assuming that the public's response to improvements in motion pictures should be any different from their response to improvements in automobiles, vacuum cleaners or refrigerators. We at Twentieth Century-Fox, therefore, are dedicated to the effort of continuing to try to improve the quality of motion pictures.

With any large screen process, the obvious major direction in which improvement can be gained, which is under the control of the producer, is to improve the definition and perspective effects achieved by the image on the screen, and to reduce the superficial disturbances due to the grain structure of the photographic image. This can be most readily done by increasing the size of the negative picture, since the ability of a piece of film to store information, and the grain pattern as well, is largely a function of the characteristics of the negative photographic material.

In engineering the CinemaScope system we utilized all the available space on 35mm film, even cutting down the width of the sprocket holes to gain more picture area. We knew, however, at the outset, that the development of large-screen pictures and the consequent increased magnification of the film image, would ultimately require us to make improvements which would yield better definition and less grain. Since there does not seem to be any likelihood of immediate and large gains in the direction of improvement of the photographic color negative itself, the obvious solution, therefore, is to use a larger negative image. The attendant problems of what to do with this larger negative image would seem to indicate that a more appropriate subject for my discussion might be: how large should this negative be?

Well, the usefulness of this larger image depends, obviously, if you wish to continue to release the pictures in conformity with the present 35mm techniques, on how well you can make reductions from the larger image, as well as considerations of lens design for the cameras and projectors. Having had years of background experience with 70mm Grandeur film and, later, with 50mm film, we were able to call upon our practical experience with these wider films, and our knowledge in laboratory processing and projector design, to bear on the overall problem. We made rather exhaustive tests of various size negative images and, with Eastman Kodak, studied the reduction problem; and, with Bausch & Lomb, studied the optical problems involved. Weighing all these factors, we came to the conclusion that a negative image of substantially four times the area of the present CinemaScope positive image represented the best engineering compromise that it was possible to make with the techniques and materials available today. Beyond this size, the gain in picture quality is small; less than this size does not give full value from the effort of making the change. Furthermore, we feel that the use of the anamorphic principle has inherent advantages which should not be overlooked or discarded.

The optical problems are, of course, crucial. A radically new approach to the printing problem was conceived in our laboratories, and brought to fruition by Bausch & Lomb's design engineers who, I may say, have done a really phenomenal piece of work in the design of reduction printing lenses, camera taking lenses and projection systems. These contributions, of course, make the difference between the success or failure of such a program as we have under consideration.

I discussed before this Society last April in Chicago in some detail our reasons for arriving at the size of negative image which we have chosen, so I shall not labor these points here. It should be sufficient to say again that our company's chief interest is in the continued improvement of CinemaScope. The program we have in hand is aimed to that end. As a part of the overall program, it is immediately apparent that we can also make release prints of a larger size than the standard 35mm release positives, and that these larger prints may be valuable from a sales point of view for use on a road-show basis to create a larger market when a picture is released for subsequent runs. Road-showing pictures has one other distinct advantage from a technical point of view — in that it is easier to set up and maintain high standards of projection in the theater where only a limited number of installations are involved. This can be an important and potent force in encouraging better projection conditions throughout the industry.

It is our present thinking that such a road-show print would be released on 55mm wide positive film, with a frame size of about 27 × 34 mm and carrying five principal stereophonic soundtracks,

together with a "surround" or "effects" track and a separate control track.

We are now making our first picture, *Carousel*, using Eastman color negative film 55.625mm wide in the cameras, and have built or are building the necessary machines to carry the improvement through to the theater screens. The results are everything we expected in screen appearance. I thought I might show you here some early laboratory tests and some of the first rushes, or "dailies," from this picture. I will simply ask you to remember that the improvement, due to having finer grain and more information in your picture, shows up even more the larger the screen and the greater the magnification. In this small room, you will see the most improvement in the seats closer to the screen where, under ordinary conditions, the present 35mm images tend to break up.

The advent of other wide film processes shows that other companies are thinking along somewhat similar lines, as witnessed by Cinerama, Todd-AO and VistaVision, and such activity is to be welcomed. Out of these developments there will inevitably emerge some process, or processes, which are better than the others, and which will, therefore, receive widespread adoption.

We may as well recognize in the beginning, as I am sure we all do, that no new process is, of itself, capable of making up for a poor picture. We have never believed that it would, nor have we believed that a very fine picture could not be made to make money today even in black-and-white. We do believe firmly, however, that if a picture is good, color will make it better, and CinemaScope with stereophonic sound, still better. We believe that the wide screen is here to stay and that these improvements which we contemplate in CinemaScope will go yet one step further in increasing the potential yield of good motion pictures.

Discussion at Roundtable on Motion-Picture Studio Production Problems

Robert A. Haines (Far East Army Motion Picture Service): Does this panel feel that the great majority of theaters in the world have installed a modern screen practically as wide as the physical dimension of the stage opening will admit? As I understand it, very few have set the screens out in front of the proscenium. Are you proceeding on the assumption that the improvement in process must confine itself to fit within that largest practical screen no matter what film width and special projection equipment are used? Do you agree that the largest possible screens are now in the majority of theaters and are you working to make improvements in other directions to fill that screen?

Loren L. Ryder (Paramount Pictures Corp.): We at Paramount are endeavoring to fill the proscenium with pictures and there is enough latitude as far as the picture is concerned to crop a little at the top or at the side to fill the proscenium. We do not believe that the theaters at large are going to tear out their prosceniums as was done at Paramount in New York. They will use the largest possible screen and then present the best possible picture. If that is what the theaters will do we're going to make our picture so it will present itself the best possible way on those screens as long as it can be done without sacrifice of quality for the big first-run theaters and if that policy would also be the policy of any other company I should see no conflict.

Gio Gagliardi (Stanley Warner Theaters): We all saw the improvement in the picture that was just shown but I would like to ask Mr. Sponable how much better it would have been if it were projected from 55mm film — that is quantitatively or qualitatively, let him describe it for us.

Earl I. Sponable (Twentieth Century-Fox Film Corp.): I haven't seen this film projected using 55mm film, but by deduction, if you will permit me to answer that way, on a sort of relative scale of values, if you would make a contact print from 55mm negative film, that's about the best you could hope to get; if you rated that at 100% of what can be put on the screen, I rate present day CinemaScope 30 to 35%. I rate this 35mm reduction from 55mm film around 70%. I think the 55mm 6-hole frame that we expect to use for custom shows will rate up around 90 to 95%.

I'd like to point out that Mr. Gagliardi has published in the *Motion Picture Herald, Better Theaters Section*, the August 6 issue, an excellent article that I recommend to everyone interested in this wide-film screen project.

Mr. Ryder: Paramount is happy to see others in the industry go to what we call the wide-frame type of picture photography. Within certain bounds there certainly is a gain available in picture quality, as pointed out by Mr. Sponable. In our opinion, if the image grows too large, the problem of depth of field of lenses comes in and the quality may not be as good as that which may be obtained in the medium-sized areas. Of course we wish that others would go horizontal instead of vertical but there are honest differences of opinion.

William A. Mueller (Warner Bros. Pictures): I feel that CinemaScope and other wide-screen processes together with stereophonic sound are responsible for the present stimulation to the motion-picture business. Consequently, we are very interested in all large-frame photographic processes and look forward to even greater values from them. We have a number of independent producers working for us, and the first thing a producer does when he buys a story is to decide how he should release it, and he usually talks to the heads of the technical departments concerned. The first way and the oldest way, and the only way formerly available, was black-and-white with a 3 by 4 aspect ratio. This is the cheapest way and certain pictures are suitable for this medium, and in fact certain ones perhaps are best in that medium.

The next question is, should he go for color? Color usually costs from $100,000 to $200,000 a picture and it depends on the type of story he has whether the added cost is justified. There is no question that color gives added value, and a great many pictures are being made in color, with justifiable cost.

Several years ago we added CinemaScope and stereophonic sound. These items cost additional sums, not nearly as large, say, as color, but they have in the past unquestionably represented added value both to the producer in his returns from the picture, and to our customers operating the theaters. Now we have another very stimulating situation opening up in which, if you have an unusual type of story, you can present it via Cinerama or Todd-AO or Super CinemaScope or VistaVision. You have additional cost but you have great values and, of course, the tremendous potential income that you can get from the right picture in the right medium, in only a few theaters.

Thomas T. Goldsmith, Jr. (Allen B. Du Mont Laboratories): This panel, I believe, has been talking quite a bit about the problems of new apparatus in converting from this kind of production to that kind of production, and some of the technical problems, but I believe most of your comments have been directed toward the theater as the end-product of your efforts. I know the panel's intent when it was laid out in the program here, but I want to consider briefly the conversion of some of your producing facilities towards making films for the television audience which, of course, is the competitor of the boxoffice theater. I wonder if you, on the panel, have a few comments on the apparatus problems and techniques of producing that have caused changes in apparatus requirements, looking toward television film as your end-product?

Peter Mole (Mole-Richardson Co.): Pertaining to the lighting problem, we, of course, come into the picture after everything else has been decided. In looking back at the lighting evolution, the type of sources of light and equipment design have always been dictated by a change in film emulsion: going forward from orthochromatic to panchromatic film, from arcs to incandescents, films from the two-color process, Technicolor process, to the

three-color process bringing in the so-called silent arc when the white light became necessary, due to the fact that the three-color process was sensitive to daylight quality.

The change from Technicolor's white light requirements to the incandescents brought on a change in lighting requirements. We knew that in advance and prepared to light at a very low level. At that time we could shoot with the new Technicolor process using 200 or 150 foot-candles and get very good results.

Then came the other revolution, the wide screen. While you could shoot and get an image on screen with 200 foot-candles, could you get the quality that you'd expect? They found in production that the levels of lighting had to go up considerably, from 800 to as high as 2000 foot-candles, to get the proper results in depth and definition. Instead of shooting at *f*/2 it was necessary to shoot at *f*/4.5 — I'm correct I think within half a stop. That brought about a lighting problem, a need for additional equipment of higher intensity. That brought about the use of the 10-kw incandescent type, the increased use of the brute and then later the requirements for the yellow carbon, which you heard about in a paper earlier on this program. I think that answers one phase of your question.

Dr. Goldsmith: I'm going to restate slightly, because this is something in which I know we at Du Mont are quite interested. One paper, which was cancelled, was directed toward changes in operations in some of the motion-picture producing companies, in view of their producing a large quantity of their product directly for television broadcasting use. Now you have been talking this afternoon, in the two papers particularly, about the problems and new apparatus required where equipment has to be put in for new processes in the theater. I wondered what problems have arisen in some of the major studios that have converted a lot of their attention toward making films for televison broadcasting use. Has that made a difference in operating requirements and philosophies in the producing business?

Mr. Mueller: The requirements for the production of television program pictures made purposely for television have not changed in the respects you've heard about this afternoon. They are being produced with the standard type of shooting that existed prior to the coming of the wide-screen process.

Mr. Ryder: In answering your question as to what we are doing in the studios that might affect the presentation of the picture on television, I would say that the aspect ratio of the picture is the greatest factor. However, we find that with VistaVision there is a great deal of latitude with respect to aspect ratios. Our pictures can be played in anything from 4 to 3 up to 2 to 1 in aspect ratio. This makes them such that they are capable of presentation on television should the television industry be in a position to pay the amount of value which we feel resides in the films that we made. Then certainly the means will be found to put the pictures out into television. Paramount is active in television. We recently acquired more studio space in Hollywood for television production, tying in with KTLA and others. We are not making any move that would be anti-television. The decisive factor that will determine what takes place is cold economics, a thing about which I was talking a little while ago.

Norwood L. Simmons, Chairman of the Roundtable Discussion (Eastman Kodak Co.): I would like to add in reply to Mr. Goldsmith's question that in Hollywood today about 80% of the television productions, meaning the half-hour serial-type shows being produced at the rate of 1 or 2 units a week for 13, 26 or 39 unit series, are being made in black-and-white, on 35mm original camera negative. The 16mm original production is negligible. The other 20% of original production is in 35mm color, and only a small part of that is being printed in color except for dailies. The dailies are sometimes being shown in color and the 35mm and 16mm prints for the networks and for syndication are being made in black-and-white, which is all that is necessary at the present time.

Edward Lachman (Lorraine Carbons): What considerations have been given to the projection of light in the new aperture sizes or film ratios?

Mr. Sponable: For the films we intend to release on a custom basis, on a roadshow basis, we are making the lighting equipment conform to the frame size we intend to use.

Mr. Lachman: I was more interested in size of carbon amperage and type of projection equipment.

Mr. Sponable: We haven't finalized the equipment specifications.

Mr. Ryder: In our case, on our double-frame projector we are using a hi-candescent type lamphouse with refractive optics because it is available and immediately meets the requirements. We have never tried reflector optics, though I think they would do very well. The lamphouses do need more consideration in order to utilize better the light energy that's being generated in the source. With respect to theater lighting, if you have proper optics you can put the same amount of light through a smaller or a larger opening. This is a matter of optics and of the film's capability to withstand heat without buckling. On black-and-white film with standard projectors you run into film burning if the lamps are as hot as you can make them. With color films, where the lamps are reasonably adjusted, I have never encountered trouble. On the large-frame projection there is no problem on black-and-white from the standpoint of damage because of excessive heat going through the film. On the question of whether or not the film buckles too much to stay in focus, this is another problem, which is one reason why we at Paramount prefer the horizontal frame.

Dr. Simmons: I would like to ask Mr. Pohl of Technicolor a question. From the standpoint of the viewer in the theater, would you say the improvements brought about by the use of larger negatives and other means of getting better definition on the screen have kept pace with the increase in size of screen itself? Is the viewer seeing a sharper picture than he saw five years ago? In other words, have the increased image size and the various equipment improvements kept pace with the increased screen size?

Wadsworth E. Pohl (Technicolor Motion Picture Corp.): Seriously, I doubt that it has.

Dr. Simmons: It is my opinion also that the improvements have not kept pace with the increase in screen size. I don't think I see as sharp a picture as I saw several years ago, granting, of course that I'm looking at a picture covering much greater angle of view.

Mr. Sponable: We knew when we went into wide-screen pictures that the increased magnification of the image on the film degraded the picture on the screen. That is the reason we're going into the use of the larger negative image today in order to bring that back and even gain some quality in the larger projected picture.

Mr. Ryder: In our experience, the best that can be done with a large-image projector certainly puts on the large screen a clearer picture than we've ever put on with the old system. But this is not entirely the result of the large negative, whether horizontal or vertical. There have been many more steps taken to improve the quality of the picture. One is the Eastman negative that we're using now, which makes single-film photography possible. In addition, Technicolor and others have evolved numerous improvements so that the films used in release in the next three months to a year will have very good quality.

So that, whereas you had a fairly satisfactory picture on a 25-foot screen in the old days with standard projection, you should have a better quality on a 40-foot screen in the near future, if you don't have it today. When we arrive at that point, by using the large-image size in projection, then the quality of the picture is better than the eye can see. Beyond this point there's a diminishing return. It's dollars put out with nothing coming in. We should get the best quality possible on standard release film by whatever process and then use the greater image sizes to meet the specific requirements of certain other theaters.

Mr. Mueller: On Norwood's question of whether we have better projection today than formerly: we used to use a 9 by 12 foot picture in our review room in the studio and now we're looking at a 20-foot picture. When we drop the picture down to the old 9 by 12 foot we're amazed how much it has improved. That improvement has come because we have modernized our projection rooms just like the theaters have. The theaters in this country, and we used to own some, so I think I know, never bought new lenses, seldom bought new screens and very little was done to modernize their equipment. Much of it was old, practically back to the early days of sound.

When this technical revolution in the business came everyone was buying new sound, new projectors, new screens, some theaters putting out five or six thousand dollars for a new screen every few months, whereas before they had not bought a new screen oftener than every five or six years. As a consequence we have a much improved quality of projection today. The greater magnification has required greater care in camera work, greater attention to focusing, high light levels, more stopping down,

smaller apertures in the camera lens, so that we try to put out a better product from the standpoint of focus and clarity.

David B. Joy (National Carbon Co.): Before I ask my question I want to second what Bill Mueller has just said that this revolution in the last few years has certainly put a lot of new and better equipment into theaters. This has helped considerably, along with what has been done in the studios, to make a better picture.

This refers to Earl Sponable's demonstration where it was noticeable that a great improvement has been made in the quality of the projected picture. Is it correct that this increase in quality is obtained entirely in the studio and requires no change in projection, in aperture or light on the screen to take advantage of it in a theater already equipped for CinemaScope except in the case of the roadshow type of presentation using 55mm film?

Mr. Sponable: That is correct.

J. F. O'Brien (Radio Corp. of America): I have some comments on the two talks given. I was very interested in the statements by Mr. Ryder on the economics of the theaters in the country. It is very encouraging that Hollywood is taking that into consideration. We, in the equipment manufacturing end, have been very conscious of that. On the question of standardization, everybody is willing to standardize on their own system, but the lack of standardization throughout the industry is holding up the forwarding of the art. You people have sold the exhibitors a terrific idea on going forward in CinemaScope, 3D and VistaVision and you've stopped for a time and you're trying to pass over on to them some of your own problems.

I would say from my own experience that the average exhibitor of the 5,000 that you speak of that have their theaters equipped for full four-track magnetic, are perfectly satisfied and would just like to get more magnetic prints out of Hollywood. So after you devise that system, now you're all cutting down the number of magnetic prints. I don't think they're the least bit interested in sharing your problem of half-track and having them buy new sprockets.

I think you've done a magnificent job. Earl Sponable here gave a demonstration which is another forward step but I think if you're going to move this whole art along and solve this problem of new projectors and arc lamps, you've got to let the manufacturers know what you're going to finally decide is the best for the motion-picture industry, but we can tell you from our own experience when Loren talks about manufacturing new projectors, that there is a terrific bill there for tooling up. You can't tool up in January and get under way and have a new process come out in May. I think with all the stuff that has been made, and you gentlemen have certainly made them, all the members of SMPTE have done a terrific job and I would urge all the equipment manufacturers that we really do get down to deciding what should be done, forgetting the roadshow, but for the bulk of this industry which is represented by the 20,000 normal-run theaters of this country, I would like to see some step toward standardization.

Ben Schlanger (Consulting Architect): In all this I see a little arithmetic missing. There should be some idea of what roadshow means, and what it means to suit the 20,000 theaters in the country for standard exhibition. What is a roadshow, what is the dramatic difference in presentation? What can bring in the big admission price of three or four dollars? That's the theater that can have a 1½ W viewing distance, i.e., the last row of seats no more distant than 1½ times the width of the picture, to have a subtended angle which gives you a dramatic surround. It needs plenty of film, 70 millimeters or over. It needs 25 foot-Lamberts or more. Why don't you design systems that are good for that? You can't do this for every theater but you can think of what's good for the average theater. Do you know the seating patterns of the theaters and what would be required to give you a good show? It may be 50mm and 20 foot-Lamberts that will do it. But now there is too much confusion.

Cinerama pointed the way. It shows what lots of film area will do, what lots of light will do and what a 1½ W viewing distance will do. Since then we've had imitations only, large blowups of pictures that have forced the audience back, and left empty that area in the theater which Cinerama uses and for which they get the highest prices.

Mr. Sponable: I think, Mr. Schlanger, when you see the opening of *Oklahoma* in New York, you'll see a theater that's exactly what you say, with a wide viewing angle, with participation, high brilliance and high definition. I think we are tending toward that and keeping it in mind.

Mr. Gagliardi: We have a screen here [in the Lake Placid Club's Agora Auditorium] that's as large as would go into the proscenium arch, yet it certainly isn't large enough for modern projection. That screen should extend from the organ pipe to the other side. But your film would be blown up so badly that you couldn't do it. You couldn't seat anybody in here to look at such a picture. Yet it would be the one thing that would make the new picture, would sell it, would keep people coming to look at it. That's the point we're trying to make for the future, in building for two, three, five years from now.

Albert D. Emurian (Philco Corp.): Understanding that it is fully recognized by all the members of the panel that television is another very large market for motion pictures, I would like to ask, by way of repeating the two questions previously raised by Dr. Goldsmith, which were not fully answered: What is the motion-picture industry doing to make motion-picture films released to the TV industry suitable for that medium? Rather than speaking of aspect ratio, I mean the taking characteristics of the film in monochrome as well as color.

Mr. Ryder: In my experience outside of my Paramount activity, the pictures for TV are largely done in closer shots and with far fewer long shots than are used for theatrical exhibition. This trend will continue until somebody finds a way of putting a large picture in the home. Then you will be able to use the long shots.

Henry Roger (Rolab Studios): Referring to wide-screen projection, I have seen performances in small theaters in Connecticut, and the only changes which were made in the theaters with wide screens were the use of a short focal-length projection lens. The heads and feet of the actors were cut off although a wide screen was used. Actually, they showed approximately only 70% of the picture. What would it take to make them do it right?

Mr. Gagliardi: In many theaters, because the screen has not been extended beyond the proscenium arch, there has been a compromise between the size of the CinemaScope picture and blown-up size of the standard picture. Also, the size of the lens has not been chosen properly. But we hope that with better training and proper information it won't happen too often.

Mr. Sponable: In the average theater throughout the country there's been a great improvement in projection and in equipment in the booth. In the past two or three years we've made more improvement than in the previous twenty. We've going through a period of change and many of the pictures being projected were shot for the old 3 to 4 aspect ratio with no head clearance or foot clearance for a 2 to 1 or a 2.55 to 1 or some other aspect ratio. The projectionist can't project that picture satisfactorily on a large screen yet he's called upon to do so. In a transition period these things are bound to take place and from this point on, I think all of us are allowing plenty of latitude so this condition should not continue very much longer in the theaters.

A List of Motion-Picture Technical Terms in Five Languages

Initiated by
CARLOS CONNIO SANTINI

Standardization of international usage in motion-picture language may not be possible, but mutual understanding of the technical terms used in the industry in those language areas where its principal activities are carried on is a worthy goal. The ferment of recent worldwide developments in the industry has complicated matters by enlarging the need for new terms. The basis for this list was contributed by Mr. Santini with no claim to its being definitive; in compiling it, however, he has tried invariably to choose the term most generally accepted in each language. This principle has also been followed by Mauro Zambuto, of Transound, Inc., Rodger Ross, of the Canadian Broadcasting Corp., Pablo Corrasco, of Kodak Colombiana, Paul Klingenstein, of Kling Photo Corp., and Denis Courtney, of the SMPTE Staff, who have scrutinized and added to the list, and by Hans Christian Wohlrab, of Siemens & Halske, who has added the German terms. It is now published for readers' comments which should be addressed to the Editor. With help from readers there will be evolved a list which can be reprinted in convenient pamphlet form as a handy working tool for motion-picture people all over the world.—Ed.

English	*Spanish*	*French*	*Italian*	*German*
General	**General**	**Général**	**Generale**	**Allgemeines**
Antihalation	Antihalo	Anti-halo	Antialone	Lichthof-Schutz
Cans	Latas	Boîtes	Scatole	Film-Büchsen
Characteristic curve	Curva sensitométrica	Courbe sensitométrique	Curva sensitometrica	Schwarzungs-Kurve
Color film	Película de color	Pellicule couleur	Pellicola a colori	Farbfilm
Color camera film	Película negativa de color	Négatif couleur	Negativo colore	Negativ-Farbfilm
Color print film	Película positiva de color	Positif couleur	Positivo colore	Positiv-Farbfilm
Composite daily	Copia diaria compuesta	Rush combiné	Giornalieri scena e colonna	Kombiniertes Muster
Composite dupe negative	Dup negativo compuesto	Contretype négatif, image et son combinés	Controtipo negativo scena e colonna	Kombiniertes Dup-Negativ
Composite original negative	Negativo original compuesto	Négatif original combiné image et son	Negativo originale scena e colonna	Kombiniertes Original-Negativ
Composite print	Copia compuesta	Positif combiné, image et son	Copia (positiva) scena e colonna	Kombinierte Kopie
Composite reversal-original	Original reversible compuesto	Originel inversible combiné image et son	Originale invertibile (*or:* scena e colonna)	Kombiniertes Umkehr-Original
Contact printing	Copia por contacto	Copie contact	Copiar per contatto	Kontakt-Kopieren
Cores	Núcleos	Noyaux	Nuclei	Filmkerne, Bobbies
Dupe negative	Dup negativo	Contretype sur duplicating	Controtipo su duplica	Dup-Negativ
Duplicating negative	Negativo duplicating (*or:* negativo para duplicado)	Négatif duplicating	Negative per duplica... (*or:* dupe)	Duplikat-Negativ
Duplicating positive	Positivo duplicating (*or:* positivo para duplicado)	Positif duplicating	(Positivo) lavander (*or:* copia lavander)	Duplikat-Positiv
Editorial process	Montaje	Montage	Montaggio	Film-Schnitt
Exhibitor	Exhibidor	Expioitant	Esercenti	Theater-Besitzer
Exposure	Exposición	Exposition	Esposizione (*or:* posa)	Belichtung
Film base	Soporte	Support	Supporto	Filmunterlage, Filmträger
Film perforations	Perforaciones	Perforations	Perforazioni	Perforationen
Final trial composite	Copia de estreno	Copie de présentation	Copia campione	Musterkopie, Abnahmekopie
Fine grain	Grano fino	Grain fin	Grana fina	Feinkorn

English	*Spanish*	*French*	*Italian*	*German*
First trial composite	Copia "A"	Première copie d'étalonnage	Prima copia (di posa)	
Fog	Velo	Voile	Velo	Schleier
Frame	Fotograma	Image	Fotogramma	Bild
Frameline	División de fotograma	Division de cadre	Interlinea	Bildstrich
Footage numbers	Números marginales	Numéros de bord	Numerazione marginale in piedi	Fuss(Meter)-Nummern
Graininess	Grano	Grain	Grana	Kornigkeit
Halation	Halo	Halo	Alone	Lichthof
Image	Imagen	Image	Immagine	Bild
Latent image	Imagen latente	Image latente	Immagine latente	Latentes Bild
Leader stock	Película leader	Film amorce	Coda bianca	Vorspann-Film
Motion-picture film	Película cinematográfica	Pellicule cinématographique	Pellicola (cinematografica)	Kino-Film, Kine-Film
Music negative	Negativo de sonido de música	Négatif son musique	Negativo colonna musica	Musik-Negativ
Optical printing	Copia optica	Copie optique	Copia in truca (*or:* stampa in truca)	Optisches Kopieren
Original picture negative	Negativo imagen	Négatif original image	Negativo originale scena	Original-Bild-Negativ
Original sound negative	Negativo sonido original	Négativ original son	Negativo originale colonna	Original-Ton-Negativ
Picture daily print	Copia diaria imagen	Premier positif image	Giornalieri scena	Positiv-Bild-Muster
Picture dupe negative	Dup negativo imagen	Contretype négatif image	Controtipo negativo	Negativ-Bild-Dup
Picture work print	Copia imagen de armado	Copie de travail image	Copia di lavorazione (scena)	Bild-Arbeits-Kopie
Raw stock	Película virgen	Pellicule vierge	Pellicola vergine	Rohfilm
Reduction printing	Copia por reducción	Copie par réduction	Stampa per riduzione	Verkleinerungs-Kopie
Release	Tiraje explotación	Tirage série	Stampa (in serie)	Verleih
Release print	Copia de explotación	Copie série	Copia (di serie)	Verleih-Kopie, Theater-Kopie
Re-recording	Regrabación	Réenregistrement	Mixage (also mixaggio, riregistrazione)	Umspielung, Überspielung
Reversal	Reversible	Inversible	Invertibile	Umkehr
Rolls	Rollos	Bobines	Rulli	Rollen
Safety base	Soporte de seguridad	Support de sécurité	Supporto (ininfiammabile)	Sicherheits-Unterlage
Sharpness	Definición	Definition	Definizione	Schärfe
Sound effects	Efectos de sonido	Effets sonores	Effetti sonori	Ton-Effekte
Sound recording	Grabación de sonido	Enregistrement du son	Incisione del suono	Tonaufnahme
Spools	Bobinas (*or:* carretes)	Noyaux	Bobine	Spulen
Temporary dupe	Contratipo negativo	Contretype sur positif	Controtipo su positivo	Zwischen-Negativ
Title negative	Negativo de títulos	Négatif titres	Negativo titoli	Titel-Negativ
Winding	Enrollamiento	Enroulement	Avvolgimento	Wicklung

Production	**Produccion**	**Production**	**Produzione**	**Produktion**
Art director	Decorador	Décorateur	Architetto	Architekt, Inszenant
Boom	Girafa	Girafe	Giraffa	Galgen
Cameraman	Operador	Opérateur	Operatore di macchina	Kameramann
Cast	Elenco	Distribution	Interpreti	Besetzung, Darsteller
Clapper	Pizarra	Claquette	Ciak	Klappe

English	*Spanish*	*French*	*Italian*	*German*
Close-shot	Detalle	Plan rapproché	Dettaglio o particolare	Nah-Aufnahme, Nah-Einstellung
Close-up	Primer plano	Gros plan	Primo piano	Gross-Aufnahme
Crane	Grua	Grue	Gru	Kran
Director	Director	Metteur en scène	Regista	Régisseur
Director of photography	Director de fotografia	Chef opérateur	Direttore della fotografia	Chef-Kameramann
Dolly	Carrito	Chariot	Carrello	Kamera-Wagen
Extra	Extra	Figurant	Comparsa	Komparse
Follow shot	Carrito	Travelling	Carrello	Fahr-Aufnahme
Location	Exterior	Extérieur	Esterni	Aussen-Aufnahme
Long shot	Conjunto	Plan d'ensemble	Campo lungo (o totale)	Weiteinstellung, Totale
Make-up	Maquillaje	Maquillage	Truccatura	Make-up, Schminke
Medium shot	Medio conjunto	Plan moyen	Piano medio (*or:* campo medio)	Halbtotale
Re-take	Retoma	Reprise	Ripetizione (*or:* rifacimento)	Wiederholung
Script	Libro cinematográfico	Découpage	Sceneggiatura (*or:* copione)	Drehbuch
Script girl	Script girl	Secrétaire de plateau	Segretaria di edizione	Scriptgirl
Set	Decorado	Décor	Scena	Dekoration
Set-up	Posición de cámara	Position d'appareil	Posizione di macchina (*or:* inquadratura)	Einstellung
Shooting	Filmación	Tournage	Ripresa	Aufnehmen
Shooting schedule	Plan de filmación	Tableau de travail	Piano di lavorazione	Aufnahmeplan
Shooting script	Libro	Scenario définitif	Sceneggiatura	Drehbuch
Shot	Plano	Plan	Piano (or inquadratura)	Aufnahme
Sound director	Director de sonido	Ingénieur du son	Fonico (*or:* tecnico del suono)	Tonmeister
Take	Toma	Prise	Inquadratura (*or:* scena)	Aufnahme, Scene
Treatment	Adaptación	Traitement	Adattamento (*or:* treatment)	Treatment
Two-shot	Americana	Plan américain	Piano americano	Doppel-Aufnahme
(*a*) *Camera*	(*a*) *Cámara*	(*a*) *Caméra*	(*a*) *Macchina da Presa*	(*a*) *Kamera*
Aperture plate	Ventanilla	Fenêtre	Finestrino	Bildfenster
Bellows	Fuelle	Soufflet	Soffietto	Balgen
Blimp	Blindaje	Boîte insonore	Blimp (*or:* schermo acustico)	Schallschutzhaube
Carrying case	Valija	Coffre	Valigia	Koffer
Drive sprocket	Rodillo dentado	Tambour denté	Rocchetto	Zahntrommel
Eyepiece	Lupa de enfoque	Oculaire de visée	Lente di messa a fuoco	Okular
Footage counter	Contador de pies	Compteur de pieds	Contapiedi	Fuss-Zähler (Meter-Zähler)
Frame counter	Contador de fotogramas	Compteur d'images	Conta-fotogrammi	Bild-Zähler
Ground glass	Esmerilado (*or:* vidrio esmerilado)	Dépoli	Vetrino smerigliato (di messa a fuoco)	Mattscheibe
Guide rollers	Rodillos de guia	Galets guide	Rulli di guida	Führungsollen
Idle rollers	Rodillos locos	Galets libres	Rulli (in folle)	Laufrollen
Lenses	Objetivos	Objectifs	Obbiettivi	Objektive, Linsen
Loop	Bucle	Boucle	Riccio	Schleife

English	*Spanish*	*French*	*Italian*	*German*
Magazines	Chassis (*or:* magazines)	Magasins	Chassis	Kassetten
Mattes	Caches	Caches	Mascherine	Kasche
Matte box	Porta caches	Porte caches	Porta mascherine	Kasch-Behälter
Parallax	Paralaje	Parallaxe	Paralasse	Parallaxe
Portable camera	Cámara de mano (*or:* cámara portátil)	Appareil pour extérieurs	Macchina portatile	Hand-Kamera
Pressure plate	Compresor	Presseur	Pressore	Andruckplatte
Register pin	Contragrifa	Contre-griffe	Contrograffa	Sperrgreifer
Shutter	Obturador	Obturateur	Otturatore	Umlaufblende
Sunshade	Parasol	Parasoleil	Parasole	Sonnenblende
Studio camera	Cámara de estudio	Appareil studio	Macchina (da studio)	Atelier-Kamera
Tachometer	Taquímetro	Tachymètre	Tachimetro	Tachometer
Tripod	Trípode	Trépied	Treppiede	Stativ
Tripod head	Cabeza de trípode	Tête du trépied	Testa(ta) panoramica	Stativkopf
Turret head	Cabeza turret	Tourelle	Testata d'obbiettivi	Objektiv-Revolver
View finder	Visor	Viseur	Mirino	Sucher
(*b*) *Sound Recorder*	(*b*) *Grabador de sonido*	(*b*) *Machine d'enregistrement du son*	(*b*) *Registratore di suono*	(*b*) *Ton-Aufnahme-Gerät*
Amplifier	Amplificador	Amplificateur	Amplificatore	Verstärker
Dubbing	Doblaje	Doublage	Doppiaggio	Nachsynchronisieren
Galvanometer	Galvanometro	Galvanomètre	Galvanometro	Galvanometer, Lichtsteuergerät
Ground Noise	Ruido de fondo	Bruit de fond	Rumore di fondo	Grundgeräusch
Magnetic	Magnetico	Magnétique	Magnetico	Magnetisch
Main amplifier	Amplificador principal	Amplificateur principal	Amplificatore principale	Hauptverstärker
Mixer amplifier	Amplificador de mezcla	Amplificateur de mélange	Amplificatore di mixage	Mischpult-Verstärker
Photographic	Optico (*or:* fotográfico)	Optique	Ottico	Licht-(Ton)
Power Supply	Fuente de poder	Source d'énergie	Alimentatore	Stromgerät
Rerecording console	Consola de grabación	Tableau de mélange	Tavolo di mixage	Mischpult
Scoring	Grabación de música	Enregistrement de la musique	Incisione musica	Musikaufnahme
Stereophonic	Estereofónico	Stéréophonique	Stereofonico	Stereophonisch
Transfer	Transcripcion	Transcription	Trascrizione	Überspielung
Voice recording	Grabación de hablado	Enregistrement du dialogue	Incisione parlato (*or:* dialogo)	Sprachaufnahme
(*c*) *Illumination*	(*c*) *Iluminacion*	(*c*) *Éclairage*	(*c*) *Illuminazione*	(*c*) *Beleuchtung*
Arc lamp	Lámpara de arco	Projecteur à arc	Lampada ad arco	Bogenlampe
Barn doors	Viseras	Coupe-flux	Paratia	Lichtblenden
Condensers	Lentes (*or:* condensadores)	Condensateurs	Condensatori	Kondensorlinsen
Fill light	Luz de relleno	Lumière complémentaire	Luce di ripieno	Zusatzlicht
Globes	Lámparas	Lampes	Lampade	Glühlampen
Jellies	Difusores de gelatina	Écran gelatine	Gelatina	Gelatine-Filter
Keylight	Luz base (*or:* luz principal)	Lumière de base	Luce base	Grundlicht
Light meter	Fotómetro	Posemètre	Esposimetro	Belichtungsmesser
Mirror	Espejo	Miroir	Specchio	Spiegel
Pedestal	Tripode	Pied	Treppiede	Stativ

English	*Spanish*	*French*	*Italian*	*German*
Reflectors	Reflectores	Projecteurs	Riflettori	Reflektoren
Silks	Difusores de seda	Écran de soie	(Schermi di seta) Velatini	Seiden-Blende
Socket	Zocalo	Douille	Zoccolo	Sockel

Laboratory	**Laboratorio**	**Laboratoire**	**Stabilimento di Sviluppo e Stampa**	**Kopieranstalt**
Daily assembling	Sincronización diaria	Synchronisation des premiers positifs	Divisione negativi (montaggio dei giornalieri)	Ausmustern
Developing solution	Baño revelador	Bain de développement	Bagno di sviluppo	Entwickler-Lösung
Developing machine	Máquina reveladora	Machine à développer	Sviluppatrice	Entwicklungsmaschine
Drying cabinet	Ropero de secado (*or:* gabinete secador)	Armoire de séchage	Essicatore	Trockenschrank
Negative developing	Revelado de negativo	Développement negatif	Sviluppo negativo	Negativ-Entwicklung
Negative light box	Mirador de negativos	Négatoscope	Negatoscopio (tavolo datore di luce)	Negativ-Lichtkasten
Notching table	Mesa de muescar	Encocheuse	Tavolo per intacche	Stanztisch
Printing department	Departamento de impresión	Atelier de tirage	Riparto stampa	Kopier-Abteilung
Printing card	Tarjeta de luces	Carte d'étalonnage	Foglio di posa	Kopierkarte
Printing machine	Copiadora	Tireuse	Stampatrice	Kopiermaschine
Print polishing	Pulido de copias	Repolissage des positifs	Smerigliatura copie	Kopie Polieren
Racks	Bastidores	Cadres	Telai	Gestelle
Rewinder	Enrolladora	Enrouleur	Avvolgitrice	Umroller
Rollers	Rodillos lisos	Diabolos	Diaboli	Rollen
Sensitometry	Sensitometria	Sensitométrie	Sensitometria	Lichtmessung, Sensitometrie
Sensitometric strips	Tiras sensitométricas	Coins sensitométriques	Strisce sensitometriche	Sensitometerstreifen
Splicing machine	Maquina de empalmar (*or:* empalmadora)	Colleuse	Giuntatrice	Klebe-Vorrichtung
Synchronizer	Sincronizadora	Synchroniseuse	Accoppiatrice	Synchronumroller
Timing	Clasificación	Étalonnage	Posa (del negativo) (*or:* luce)	Lichtbestimmung
Waste	Descarte ó merma	Perte	Sfraso	Abfall
35mm Black-and-white	*35mm Blanco y negro*	*35mm Noir et blanc*	*35mm Bianco-nero*	*35mm Schwarz-weiss*
Developing	Revelación (*or:* revelado)	Développement	Sviluppo	Entwicklung
Picture negative	Imagen negativa	Négatif image	Negativo scena	Bild-Negativ
Soundtrack negative	Negativo sonido	Négatif son	Negativo colonna	Ton-Negativ
Printing dailies	Copias diarias	Premiers positifs	Copie giornaliere	Musterkopien
Picture only	Imagen solamente	Image seule	Sola scena	Nur Bild
Sound only	Sonido solamente	Son seul	Sola colonna	Nur Ton
Composite	Imagen y sonido	Image et son combinés	Scena e colonna	Kombiniert
Release prints	Tiraje de copias	Copies standard	Copie (di serie)	Verleihkopien
First trial composite	Copia "A"	Première copie standard	Copia campione	Erste kombinierte Musterkopie
Release prints	Copias de explotación	Copies de série	Copie (di serie)	Verleihkopien
Print track for dubbing	Copia de sonido para regrabación	Positifs son pour réenregistrement	Positivo colonna per mixaggio (*or:* premixaggio)	Tonkopie für Synchronisation
Duping prints	Copias master	Positifs pour contretype (marron)	Copie lavander	Lavendelkopien

English	*Spanish*	*French*	*Italian*	*German*
Fine-grain prints for optical work	Copias master para truca	Positifs marron pour truca	(Copie) grana fina per truca	Feinkornkopien für Trick
Paper to paper	Papel a papel	Fil à fil	(Stampa) da filo a filo	Von Klammer zu Klammer
Dupe-negatives	Dup-negativos	Contretypes	Controtipi	Dup-Negative
Superimposed prints	Copias con títulos sobreimpresos	Copies standard sous-titrées	Copie con titoli sovraimpressi (*or:* con sottotitoli)	Kopien mit Untertiteln
Title negative	Banda de títulos	Négatif sous-titres	Negativo titoli	Titelnegativ
Trailers	Colas de propaganda	Films-annonces	Presentazioni	Trailer, Vorspannen
Leaders	Colas	Films amorces	Code	Vorspannen
Frameline leader	Cola recuadrada	Film amorce recadré	Coda fotogrammata	Bildstrich-Vorspann
Clear leader	Cola transparente	Film amorce transparent	Coda transparente	Blankfilm-Vorspann
Black leader	Cola negra	Film amorce noir	Coda nera	Schwarzfilm-Vorspann
Start leader	Cola de start	Amorce départ	Coda di partenza	Start-Vorspann
Splicing and blooping	Pegaduras y bloqueo de sonido	Collures et blocage son	Giunte e lunette	Kleben
Projection room	Sala de proyección	Salle de projection	Sala di proiezione	Vorführraum
Vault	Depósito	Dépot	Deposito (*or:* casamatta, loculo)	Film Tresor
Latensification	Latensificación	Latensification	Latensificazione	Latensifikation
Cutting rooms	Salas de montaje	Salles de montage	Stanze di montaggio	Schneide-Räume
Photographing titles	Filmación de títulos	Prise de vues des titres	Ripresa dei titoli	Titel-Aufnahme
Main titles	Títulos de presentación	Génériques	Titoli di testa	Haupt-Titel
Subtitles	Títulos sobre-impresos (*or:* subtitulos)	Sous-titres	Sottotitoli	Untertitel
Inserts	Inserts	Inserts	Inserti	Zwischenschnitte
Main title cards	Cartones de títulos presentación	Cartons pour génériques	Cartoni dei titoli di testa	Haupttitel-Vorlagen
Hand lettered	Dibujados	Dessinés	Disegnati	Handgesetzt, handgeschrieben
Printed	Impresos	Imprimés	Stampati	Gedruckt (Titel)
Special effects	Efectos especiales	Prises de vues	Effetti speciali (*or:* trucchi)	Spezial-Effekte
Optical printing	Truca	Truca	Truca	Optisches Kopieren
Fades	Esfumaturas	Fondus	Fondu o dissolvenza	Abblendungen
Lap dissolves	Sobreimpresiones	Enchainés	Dissolvenza incrociata	Überblendungen
Wipes	Cortinas	Volets	Tendine	Seitliche Überblendungen
Zooms	Acercamiento	Travelling	Carrelli	Optische Fahrten
Miscellaneous	Trabajos varios	Travaux spéciaux	Lavori speciali	Allgemeines
Tinting	Coloración	Coloration	Imbibizione	Einfärbung
Toning	Viraje	Virage	Viraggio	Tonung
Magnetic striping	Aplicación de banda magnética	Couchage de piste magnétique	Applicazione della pista (sonora) magnetica	Magnetschicht-Begiessung
16mm Black-and-white	*16mm Blanco y negro*	*16mm Noir et blanc*	*Bianco-nero 16mm*	*16mm Schwarz-Weiss*
Developing	Revelado	Développement	Sviluppo	Entwicklung
Reversal	Inversión	Inversion	Invertibile	Umkehr

English	*Spanish*	*French*	*Italian*	*German*
Printing	Impresión	Tirage	Stampa	Kopieren
Contact from 16mm negative	Contacto, de negativo 16mm	16mm sur 16mm	Per contatto, da negativo 16mm	Kontakt von 16mm Negativ
Reduction from 35mm negative	Reducción, de negativo 35mm	35mm sur 16mm	Riduzione da 35 a 16mm	Reduktion von 35mm Negativ
"A" & "B" printing	Copia A-B	Copie A-B	Stampa A-B	A & B Kopie
Reels	Carreteles	Bobines	Bobine	Spulen
Cans	Latas	Boîtes	Scatole	Büchsen
Electronic printing	Reducción sonido por regrabación (*or:* copia electronica de sonido)	Réenregistrement électrique	Riduzione elettronica del suono (*or:* stampa colonna per riregistrazione)	Elektrische Kopierung
Optical reduction	Reducción optica	Réduction optique	Riduzione ottica	Optische Verkleinerung
Blow-up	Ampliación	Agrandissement	Ingrandimento	Vergrösserung

35mm color	*Color 35mm*	*Couleur 35mm*	*Colore 35mm*	*35mm Farbfilm*
Color cinex test	Banda de filtraciones	Bande de réglage	Bandino di prova	Farbbestimmungsprobe
Daily print	Copia "Cero"	Premier positif	Copia giornaliera	Musterkopie
First trial color composite	Copia "A"	Première copie d'étalonnage	Prima copia con correzioni	Erste kombinierte Farbfilmmusterkopie
Single run negative	Negativo único	Négatif unique	Negativo unico	
A & B negative	Negativo A-B	Négatif A-B	Negativo A-B	A & B Negativ
Positive separations	Separaciones positivas	Extraction des monochromes	Interpositivi	Positiv-Auszugskopien
Internegatives	Internegativos	Internegatifs	Internegativi	Zwischennegative
Matrices (Techni)	Matrices	Matrices	Matrici	Matrizen

Some Principles of Spray Processing

By JOHN R. TURNER
and EINAR W. JENSEN

The spray application of developing solutions sensitive to oxidation requires that an inert spray atmosphere be used. Methods are described to accomplish this relatively simply and inexpensively. Experimental studies have been made of spray nozzle arrays for a variety of processing conditions. The factors that may affect the design of spray processing machines are discussed.

Conventional methods of processing photographic materials involve immersion in the successive processing solutions. These methods generally require the use of some means of agitating or stirring the liquids in order to maintain fresh solution at the correct temperature in sufficiently intimate contact with the emulsion surface.

The advantages of open spray application of processing solutions over liquid immersion have been generally appreciated for many years. The rapid oxidation of developers has been a major deterrent to the broad use of spray techniques for photographic development. Spray washing has received much more general use, limited to some extent by the space available in processing machines originally designed for liquid immersion operation.

Black-and-white films have been processed by spray methods in certain special cases. For example, the DeLuxe Laboratories[1] for the past fifteen years have processed with spray techniques some motion-picture films for which an exceptionally high degree of uniformity is required. Such uses of spray processing are sufficiently advantageous that any added cost resulting from aerial oxidation of solutions within the processing cabinets is of secondary consequence. In the absence of oxidation the benefits of extreme uniformity and shortened process time afforded by spray application could be realized more generally in processing operations.

Conclusions in this paper are based on the results of laboratory experiments and engineering design directed toward the efficient use of spray processing both for monolayer silver films and for multilayer color materials. These studies were undertaken because of the need for improved machines for the processing of some color films.

Agitation in Photographic Development

The effects of agitation in the development of monolayer silver films have been discussed extensively in the literature. In the development of multilayer color films between-layer differences of speed, contrast and curve shape are associated with different levels of agitation. For this reason uniform and suitable agitation is highly important for the processing of these materials.

When film is developed under static hydraulic conditions, there accumulates at the emulsion surface a layer of reacted solution which can be quite different in chemical composition from the main body of solution in the tank. Methods of displacing this layer have been discussed by Ives and Jensen.[2] Of particular interest in their paper are several sets of curves showing the effect of increasing intensity of agitation on the growth of density and gamma for positive motion-picture film.

One set of the curves from their paper is shown in Fig. 1. Similar curves describe the corresponding development characteristics of color films. It is apparent from these curves that relatively large photographic differences occur for small changes in degree of agitation at low agitation levels. However, as intensity of agitation is increased, these curves shoulder off to plateaus along which increased intensity of agitation produces no appreciable photographic difference. Under these conditions the surface layer is so effectively displaced that the reaction is insensitive to moderate changes in agitation.

We refer to the agitative condition existing along the plateau portion of the curve as "saturation scouring." This may be achieved either by continuous displacement of the surface layer, or by a more intense treatment periodically. Both the required intensity and frequency are easily determined experimentally for a given film and process.

Spray Application of Processing Solutions

Spray application is a particularly efficient and economical way to obtain high scouring intensities. The adaptation of an immersion-type processing machine to a form of open spray application was described by Leshing, Ingman and Pier.[3] Ives and Jensen[2] have stated that spray development undoubtedly has great potentialities but must await further study. Offenhauser[1] has discussed the spray application machines of DeLuxe Laboratories and refers to the basically sound principles of open spray application. Various rapid processing machines[4] use spray application to obtain sufficiently intense scouring for the high reaction rates associated with these processes.

Continuous Processing

Full-Spray Coverage. Full-spray coverage has been applied in these experiments to continuous processing in a laboratory machine designed specifically for the purpose. This machine, shown in Fig. 2, consists of a stainless steel chamber provided with a sealed cover; it is mounted on a frame and equipped with a drive motor and a solution recirculation system. A removable rack with a closed loop helical threadup is positioned within the chamber in proper relationship to the array of spray nozzles and to the drive coupling. The recirculation system is located below the chamber and incorporates a pump, heat exchanger and several electrically actuated, pneumatically operated valves which facilitate rapid change of solutions being recirculated. Re-exposure units are provided within the chamber in order to carry out various reversal color processes.

To operate this experimental machine, the rack is first loaded with film, placed in the processing chamber, and the cover clamped on. The chamber is purged with nitrogen to reduce the oxygen concentration to less than 0.25% and a slight flow of nitrogen is maintained. The film drive is turned on at the desired speed and the successive solutions are then each introduced in turn for the required times.

The spray nozzles are supported within the chamber by the supply piping which is designed to permit adjustment in the positions of the individual nozzles. The spray pattern is a series of overlapping flat cones applied at an angle of about 13° to the film. Three flat atomizing nozzles (Spraying Systems Co. #1/8 VVSS8002) are spaced 4 in. apart vertically and about $1\frac{3}{8}$ in. from the film. The liquid flow per nozzle is 0.1 gpm at the operating pressure of 10 psi.

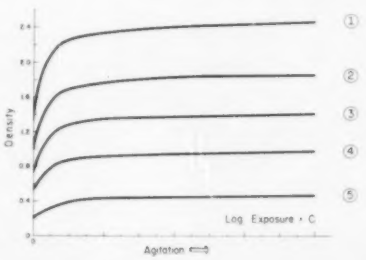

Fig. 1. Typical density-agitation characteristic (data of Ives and Jensen).

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(This paper was received on January 3, 1956.)

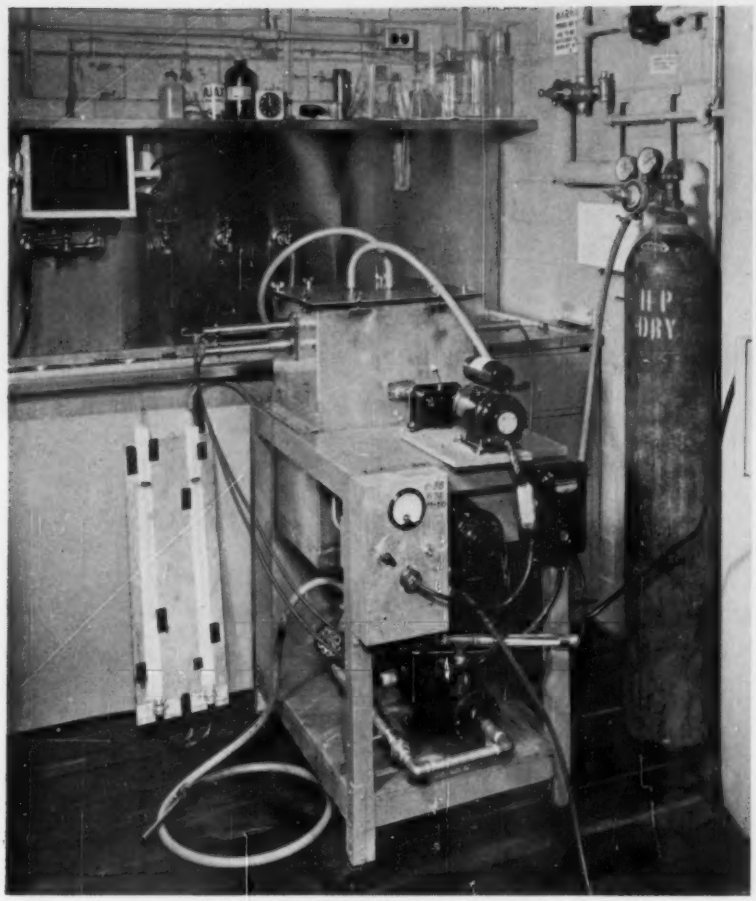

Fig. 2. Laboratory machine for spray processing.

Full-coverage spray application as described is mainly useful for processing in a fixed position, or on continuous machines operating at very low speeds. The systems of full coverage application studied here have several serious limitations for use on large production machines. The number of nozzles required and the associated flow rates become impractically large. In addition to this, the nozzle orifices are so small that extreme precautions must be taken to prevent plugging.

Periodic-Spray Application. The spray chamber just described was modified to incorporate several rows of flooding nozzles (Spraying Systems Co. #1/8 KSS5), adjustable in spacing and in number, for studies of periodic application. In this type of solution application the permissible time interval elapsing between scourings is determined by the film and process. It is to a first approximation independent of the speed of operation of the machines. The distance between sprays is determined by this time interval and by the speed of the machine.

These flooding nozzles have a minimum opening of 0.078 in. and were found to discharge about 0.5 gpm at the operating pressure of 10 psi. The fan-shaped sprays from these nozzles are applied at an angle of 45° to the film at a perpendicular distance of $1\frac{3}{4}$ in. to the center line of the nozzle as shown in Fig. 3. As placed in a row across a series of strands in a larger scale processing machine the nozzles are spaced on 7-in. centers horizontally. This provides an overlap of 1 in. of adjacent fans. All nozzles are stationary and the flow is continuous. The time interval between sprays has ranged from 1 to 4 sec depending upon the type of film and the process. Sufficiently high intensity is obtained for saturation scouring, and at the 45° angle of impingement the position of film strands running under moderate tension is not seriously disturbed. We have recently been informed that some of the spray machines in successful commercial operation use similar nozzles and somewhat similar arrays.

This experimental machine has proved to be very useful for the study of spray processes for a variety of photographic materials. The density uniformity is excellent, and the repeatability from run to run is within close limits.

Processes worked out on the small machine can be translated directly to larger-scale spray equipment with scarcely any adjustment in process being required.

Oxidation as a Problem

The severe developer oxidation that may occur during spray development is important in these respects:

(1) Cost of the chemical used;
(2) Photographic characteristics and process control.

While Levenson[5] has found that under certain conditions black-and-white developers can be sprayed into air of normal oxygen content without severe oxidation, this certainly is not true of many of the developing solutions used for color photographic materials. Both the relatively high cost of color developers and their general susceptibility to oxidation dictate an inert spray atmosphere.

The exhaustion characteristics of many color-developing solutions are such that even moderate oxidation is sufficient to cause marked degradation of the images developed in the presence of this oxidation. Thus, even though cost were a secondary consideration, spray application in air would be quite impractical.

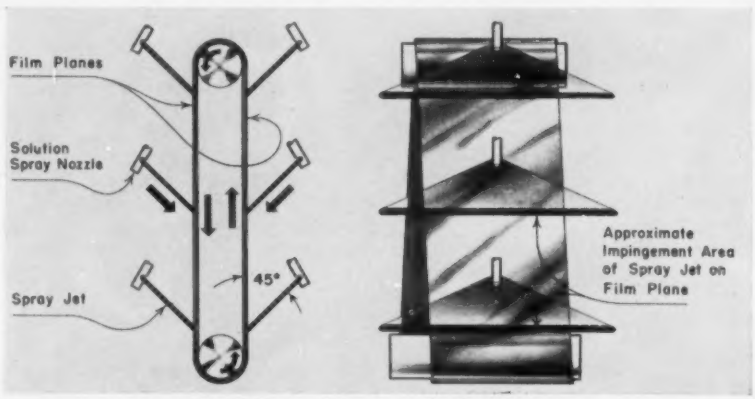

Fig. 3. Interval spray application system.

Prevention of Developer Oxidation in Spray Processing. Developer oxidation in a spray-processing machine can be effectively prevented by the following measures:

(1) Purging of contained oxygen from the developing cabinets at start-up, or after opening;
(2) Pressurizing of developing cabinets with nitrogen;
(3) Sealing of cabinets to prevent nitrogen loss.

The purging of oxygen from a cabinet is conveniently accomplished by the discharge of a quantity of nitrogen through a distributor at the bottom of the cabinet as shown in Fig. 4. Gas discharged from the cabinet is exhausted through a cover at the top. If the contained gas in a cabinet could be completely displaced without mixture with the admitted nitrogen, obviously one cabinet volume of nitrogen would be sufficient. A more practical possibility is diluting the contained air to a permissibly low oxygen content. Experience has shown that a well distributed nitrogen discharge amounting to 3 cabinet volumes is adequate for this purpose.

The pressurizing of developer cabinets need only be enough to prevent infiltration of room air through minor leaks. A pressure of $\frac{1}{8}$ in. of water is sufficient for this purpose. While a gas pressure regulator might be warranted in a large installation to minimize nitrogen gas consumption, the present experimental practice employs a needle valve and gas flow rotameter set to deliver a moderate flow. Excess gas is discharged through a cabinet cover which rests in a water-filled channel.

The sealing of spray cabinets has in the past presented practical difficulties. The use of inflatable gaskets overcomes a major obstacle, that of sealing the cabinet doors. The B. F. Goodrich Co.[6] manufactures an inflatable gasket which is designed to fit around a glass panel. The tubular gasket is of rectangular cross section folded into itself when not inflated. An H-section extruded rubber strip fits around the glass panel and contains the inflatable tube as shown in Fig. 5. Since all of the sealing forces are balanced and in the plane of the panel, no appreciable strain is placed on the door fastenings. Errors in fit of the door opening of up to $\frac{1}{4}$ in. are accommodated. The main restrictions are that the surface of the door opening be smooth and that the opening be more closely fitted at the rounded corners.

The present spray processing experiments have shown that developer oxidation can be reduced to an inconsequential amount by suitable design of the spray machine and auxiliary equipment. The attractive possibility is presented of a developing and solution storage system operating completely under a nitrogen atmosphere. The use of an inert spray atmosphere is particularly important at elevated temperatures because of the higher reactivity of developing solutions at these temperatures.

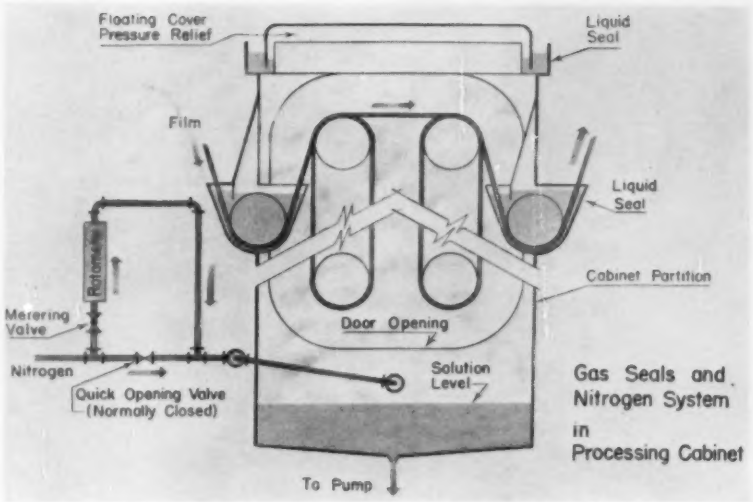

Fig. 4. Gas seals and nitrogen system in processing cabinet.

Mechanical Requirements for Spray Processing

It is a primary requirement of film drives used for spray processing that an adequate minimum tension be maintained throughout the spray cabinets. This is necessary in order to resist the spray impingement forces and to avoid the occurrence of running overlaps of adjacent strands due to surface tension. Once such running overlaps have formed, they may continue for an extended period unless separated by the machine operator.

The spray system previously described does not deflect the film greatly from its normal path provided that the loops are not more than 6 ft in height and the film tension does not drop below 4 oz on 16mm film, or 8 oz for 35mm film.

Attempts in these experiments to utilize the conventional bottom-drive system for spray processing were unsuccessful because of the nearly zero film tension on the up-going strands.

A modified bottom drive which has been used by one commercial laboratory in deep tank machines seems to be particularly suitable for spray machines. This drive is described in U.S. Patent 2123455 issued to J. F. VanLeuven in 1938. The drive consists of individually pivoted and weighted bottom film rollers supported by the film strands. Each bottom roller is lifted by film tension against a positively driven friction disk. The action is closely similar to that of the conventional bottom drive except that an adequate minimum tension is assured at all times. This drive is relatively expensive to build, but it does have the advantage of loop-to-loop tension control. In these experiments this drive has been particularly convenient as a modification to the original design. Probably other drives in commercial use on immersion

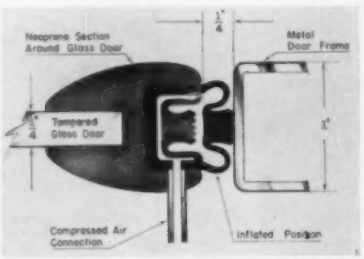

Fig. 5. Inflatable seal for spray cabinet doors.

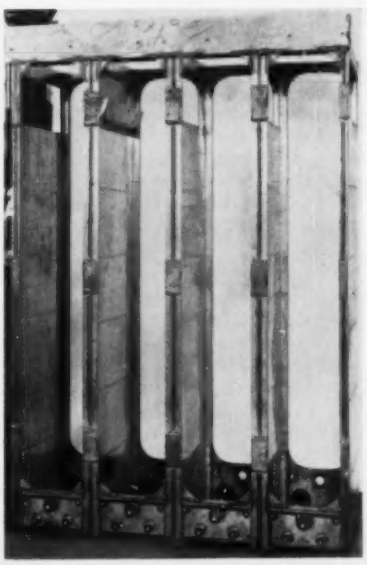

Fig. 6. View of 4-chamber spray processing cabinet, showing typical light gauge construction.

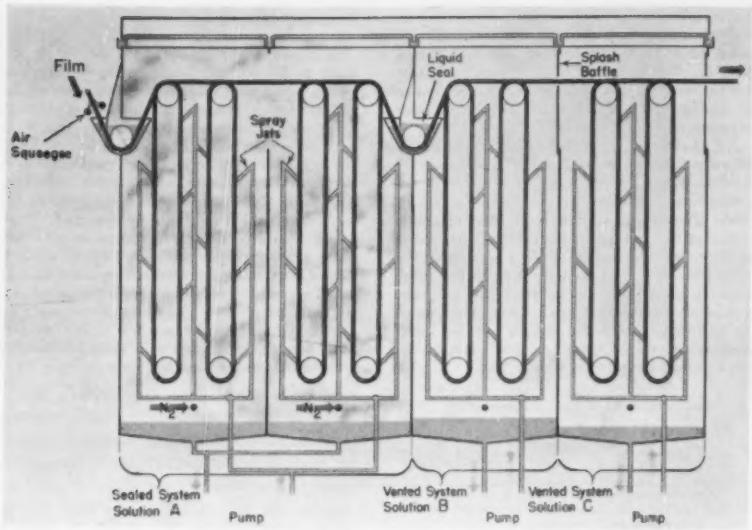

Fig. 7. Film thread-up and liquid system in 4-chamber spray cabinet.

machines would be quite satisfactory for spray processing.

Description of Experimental Section of Spray Processing Machine

A four-chamber cabinet as shown in Fig. 6 has been built for experimental spray processing in a nitrogen atmosphere. The partitions and lower portion of the cabinet are made of light gauge 316 stainless steel formed and welded. The doors are tempered glass panels fitted with inflatable gaskets. Doors are placed on both sides of the cabinets. The spray nozzle array is the interval type previously described. The spray assemblies are set into O-ring seals and are easily removable. At the completion of each stage in the process, the film passes through a liquid seal as shown in Fig. 7. Exhaust caps made of unplasticized polyvinyl chloride, set in water-filled channels, cover each chamber. There are two helical banks of film in each chamber. Individual weighted loop bottom-drive is used with 4% overdrive with respect to the pull-out pacer.

This cabinet has been set up as a test unit and is being run experimentally as a portion of a continuous machine, the remainder of which is a conventional liquid immersion processor. The nitrogen usage is 6 cu ft/hr for a cabinet containing 400 ft of 16mm film. Nitrogen gas costs approximately $1\frac{1}{2}$¢/cu ft when purchased in 200-cu ft capacity cylinders or $\frac{3}{4}$¢/cu ft in 10,000-cu ft capacity trailer truck cylinders. The usage could be substantially reduced through the use of a pressure regulator.

Special Precautions and Limitations

There are a number of difficulties and limitations inherent in spray machines.

A strand of film entering a spray developing cabinet should receive an immediate and thorough application of solution. Otherwise spatter droplets impinging on the film may produce spots and streaks.

It is difficult to use blow-back squeegees in developer cabinets since the air used must be exhausted separately. Blow-backs are conveniently installed in spray washes preceding a developer. The liquid seal between the wash and the developer is filled with developing solution.

Processing solutions designed for tank machines must usually be adjusted in composition to meet the same process aim point under spray conditions, just as similar adjustments are sometimes made to compensate for differences between tank machines.

Film in a spray processing machine is not directly visible for close examination. Open top immersion machines afford a better opportunity for immediate detection of physical or photographic troubles. It is possible, however, that viewing ports could be incorporated in spray machines. For these a higher illumination would be permissible than could be tolerated in an open machine room.

Advantages of Spray Processing Machines

In addition to excellent uniformity of processing, spray machines offer a number of other potential advantages.

The ready access to film in process afforded by spray machines with side-opening doors assures a minimum film loss in the event of breaks in the threadup. In addition to this, minor mechanical difficulties can be detected and corrected without shutting down operation. The essential parts of the machine are directly accessible for maintenance during shut-down periods.

Many color processing solutions contain volatile constituents which pass into the room air from open-tank machines. These are effectively contained within spray machines thereby preserving the solution and protecting the machine operators. Vapors are released when a cabinet is opened, but these can be effectively removed by suitable exhaust provisions at the machine.

The ease of installation of spray machines makes them particularly attractive. The relatively low headroom required and the light floor loading permit such machines to be installed in buildings which would be unsatisfactory for deep-tank machines.

A considerable degree of flexibility for process changes is desirable on machines used for processing color film. Spray machines can be built of modular units of light construction, carried on a light supporting structure. All liquid connections are conveniently made along the sides of the machine at the bottom. Thus, it is quite feasible to run chemical lines and water lines along the machine in such a manner as to permit changes in the connections to individual cabinets without extensive repiping.

The results of this initial phase of these processing studies have been presented because of the active interest which many have expressed in this subject.

Any future recommendations for the spray processing of specific color films will be dependent on the results of further work on a larger scale.

Acknowledgment

The authors acknowledge the considerable assistance given by co-workers in the Color Technology Div., and the engineering design contributions of W. McFadden and W. Hausler of Engineering, Construction, Maintenance and Utilities of the Eastman Kodak Co.

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Discussion

W. E. Pohl (Technicolor, Inc.): With regard to the seal that you have at the entrance to the developing tank, what do you do to replace the developing solution there—do you dump it into the drain at some specified rate?

Mr. Turner: The solution is supplied to the seal at a rate somewhat less than the overflow rate that is required from the developing system to compensate for the normal rate of replenishment.

Mr. Pohl: You can't return that developer to the active solution though?

Mr. Turner: No, this is waste developer. It is fed through the seal at a sufficient rate to maintain it in satisfactory condition, but overflows to the sewer from there.

N. J. Cedrone (Artisan Metal Products, Inc.): What reduction in time has been indicated by your work to date? What maximum reduction do you expect in processing time?

Mr. Turner: This, as I understand it, is time reduction due entirely to increased agitation. It varies considerably for different films and processes; a process and film in which the rate was being limited rather severely by low agitation might be reduced by as much as a factor of two. But a much more usual value would be something in the order of 25% reduction. Any process where spray application reduced the developing time much more than this was probably under-agitated before.

J. I. Crabtree (Eastman Kodak Co.): How much difficulty do you have with clogging of the spray nozzles, due either to imperfect filtration or possible crystallization?

Mr. Turner: There has been some clogging occurring under experimental conditions where no filter was being used. With a filter, no difficulty has been encountered. Obviously, solid particles in the developing solution, of a size approaching that which would cause plugging of the 0.078-in. bore of the nozzles used in these experiments, might cause physical damage to film to which the solution was applied.

Authors' Note

A closed spray processing chamber is not likely to dry out sufficiently during shutdown to cause the trouble due to crystallization at the spray nozzles referred to in Mr. Crabtree's question. A more serious difficulty can occur with developers which leave scale-like deposits in the recirculation lines. Under extreme conditions such deposits can build up over a period of time, and later become dislodged from the surfaces on which the build-up occurred. Such difficulty has occurred on immersion machines using submerged jet agitation. Spray application of developing solutions having these characteristics necessitates frequent cleaning of the recirculation piping. A further precaution is the provision of protective screens at the nozzles. Such screens are included in some commercial spray-nozzle assemblies.

Acceleration Accuracy: Analyses of High-Speed Camera Film

By DERWYN SEVERY and PAUL BARBOUR

Acceleration due to gravity, g, was experimentally determined using the technique of micromotion analysis of high-speed motion-picture film taken of a steel sphere in free fall. Three methods of film analysis were compared with an independently calculated value of g. The analyses used and the error they produced were as follows: graphical, 6%; graphical-analytical, 1%; and analytical, 2%. For all of these experiments, a Bausch & Lomb Contour Measuring Projector was used.

Since high-speed photography's recording of velocity and acceleration phenomena has become indispensable, it is likewise essential to recognize the source of errors introduced during the process of data reduction and the influence the errors have on the accuracy of final results. Acceleration due to gravity, g, as described in this paper, was determined using the technique of micromotion analysis of high-speed motion-picture film taken of a steel sphere in free fall.

The purpose of these experiments was to determine the accuracy of micromotion technique as applied to acceleration measurements.

Experimental Procedure

An Eastman high-speed motion-picture camera, Type III, was used to photograph the acceleration due to gravity of an 8-lb solid steel sphere in free fall. The sphere was dropped from a platform 40 ft above a wooden box filled with an energy-absorbing material (Fig. 1). The sphere was photographed as it passed through the 28–34-ft segment of its 40-ft fall. A background of white paper provided the necessary photographic contrast for the black sphere. A 6-in. wide, 20-ft long calibrated wooden marker board was oriented centrally and vertically through the photographed segment of the sphere's path. This marker board, with its 1-ft alternate black and white segments, provided the reference necessary for the conversion of the measurements made on the film in inches to the distance in feet actually traversed by the sphere. An argon timing light was directed against one edge of the film. This light was operated by a 60-cycle source* which printed timing marks on the film at a rate of 120/sec. An auxiliary timing device was used which consisted of an electric clock with a fast sweep hand giving time in hundredths of a second. This clock was oriented so that it appeared in focus on the film, without interfering with the observations being made of the sphere.

This experiment was repeated twice so that film speeds of 300 and 1800 frames/sec could be used. In each test, after the camera had been given time to accelerate, two solid steel spheres were dropped in rapid succession. These objects were selected because their uniform configuration and high density provided a basis for making accurate allowance for the forces of drag and buoyancy in the calculation of the gravitational constant. For determining the gravitational constant, the speed of 300 frames/sec was found to provide enough information. The auxiliary timing unit was not used in the film analysis because of difficulty encountered in taking readings from the clock due to glare. However, it is generally advisable to have an auxiliary timing system,* where accelerations or similar measurements are being made, since occasionally the photographed timing mark is either too obscure to read or is completely missing due to electrical failure of the timing circuit.

Data Reduction

Generally, there is no reliable method

Presented on April 21, 1955, at the Society's Convention at Chicago, by Derwyn Severy (who read the paper) and Paul Barbour, Institute of Transportation and Traffic Engineering, University of California, Los Angeles 24.
(This paper was received on April 4, 1955.)

* The possible error of 0.2% due to frequency variations of city power was found not to introduce objectionable error for this experiment. For high-speed photography requiring extremely precise timing, a crystal-controlled oscillator, preferably one that thermostatically controls the crystal temperature and with subsequent frequency dividers, should be used as a source for internal and external timing.

* A strobe light pulsed by a crystal oscillator or a centisecond clock with a nonglare face and connected to a reliable power source provides satisfactory auxiliary timing.

for estimating the error associated with the values of accelerations obtained by high-speed photographic analysis*. This paper serves to identify briefly the nature and magnitude of errors resulting from three approaches to the determination of acceleration from high-speed photography. The errors, in this case, may be correctly evaluated owing to the extreme accuracy with which the acceleration due to gravity may be calculated for a given locality and without need of reference to film data. The acceleration so obtained provides a reliable reference for error determination of accelerations derived from high-speed photography.

The frame-by-frame analysis of the motion-picture film consisted of making measurements of the distance the sphere progressed between successive frames of the film. These measurements were made on the film to 0.0002 in. by use of the Bausch & Lomb Contour Measuring Projector. By measuring the length on the film, in inches, of a 1-ft segment of marker board which had been photographed at the same range as the falling sphere, a conversion factor was provided for translating the distance measurements of the sphere in inches of film to feet of actual fall. By referring to the timing marks on the edge of the film, the number of frames between each 1/120-sec mark were plotted for the section of film being analyzed to provide the film acceleration curve in terms of frames/sec vs. frame number. This plot provided the incremental time data for each frame measurement taken in the manner already described. The film speed was found to increase linearly over the section under consideration and was plotted as a function of frame number to facilitate the analysis.

Data reduction to this point has consisted of assemblage of the incremental distance-time measurements for each frame of the section of film being studied. Three solutions for acceleration were made from these basic frame-by-frame Δs, Δt data. They were: graphical, graphical-analytical and purely analytical. The purpose of this triple approach to the solution was to determine the method which produced the most accurate accelerations as well as the absolute and relative accuracy of each method. This is important to know because the double differentiation process necessary for obtaining accelerations from distance-time data characteristically magnifies quite greatly the errors made in measuring distances and times for each frame. Minimization of these errors is essential to the obtaining of reasonably accurate accelerations, as will be explained below under "Discussion of Error."

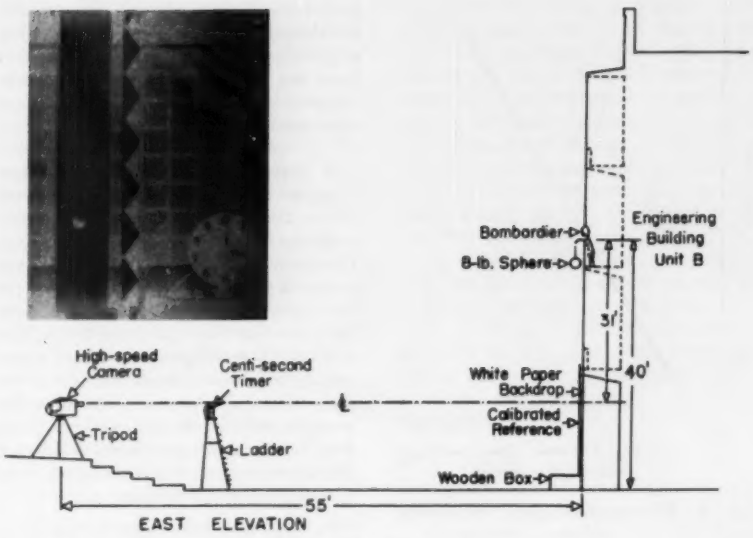


Fig. 1. Plan of test site.

The Analysis

Three solutions for acceleration were obtained from the basic frame-by-frame incremental distance and time data. The procedure for these solutions and their respective errors are indicated diagrammatically in Fig. 2.

Figure 3 shows the distance-time plot for the falling sphere and the smooth curve which was fitted visually to this plot. The smooth distance-time curve of Fig. 3 was used in both the Graphical and Graphical-Analytical solutions for acceleration. The solutions for acceleration were facilitated by the fact that the acceleration of the sphere was known to be constant over the short distance of free fall being analyzed. The correct velocity-time curve is, therefore, a straight line, the slope of which is the acceleration due to gravity. However, the small errors of measurement of distance-time data cause the velocity-time plot to look more like a scatter plot (Fig. 4), making it necessary to fit a straight line through the plot in order to define the

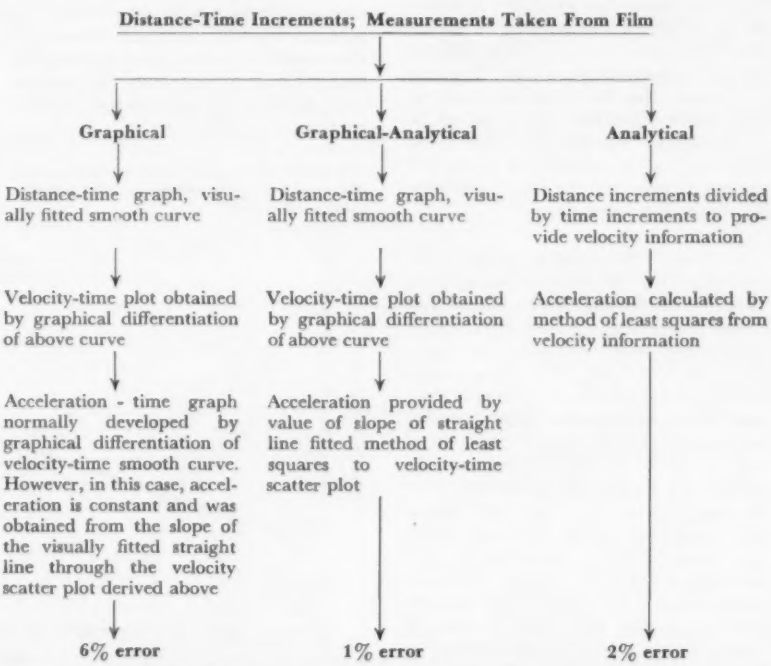

Distance-Time Increments; Measurements Taken From Film
Graphical
Graphical-Analytical
Analytical
Distance-time graph, visually fitted smooth curve
Distance-time graph, visually fitted smooth curve
Distance increments divided by time increments to provide velocity information
Velocity-time plot obtained by graphical differentiation of above curve
Velocity-time plot obtained by graphical differentiation of above curve
Acceleration calculated by method of least squares from velocity information
Acceleration - time graph normally developed by graphical differentiation of velocity-time smooth curve. However, in this case, acceleration is constant and was obtained from the slope of the visually fitted straight line through the velocity scatter plot derived above
Acceleration provided by value of slope of straight line fitted method of least squares to velocity-time scatter plot
6% error
1% error
2% error

Fig. 2. Diagram of procedure followed in the analysis for acceleration.

* It has been the practice of the senior author in his impact research to parallel the high-speed photography instrumentation, where possible, with both electrical and mechanical accelerometer sensing units so that the reliance placed on any given system may be related to the substantiation provided by the other two.

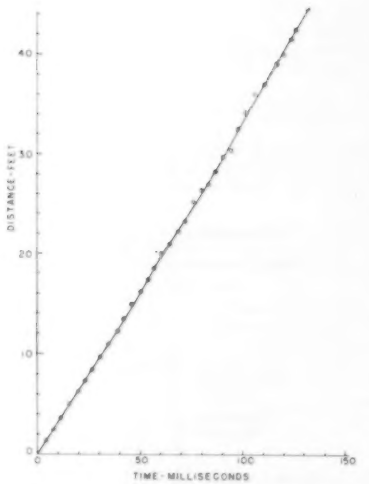


Fig. 3. Distance-time plot for falling sphere.

velocity-time curve. The introduction of curve fitting by the method of least squares reduced the errors of judgment common to visual curve fitting by 5%.

The results of the analysis providing the calculated value of the gravitational constant, which was used as the reference for error calculations, are presented in the appendix, as are the Analytical and Graphical-Analytical solutions.

Discussion of Error

Securing accurate acceleration histories of objects is difficult and in some cases not possible for certain systems of instrumentation. Because acceleration cannot be quantified by direct measurement, the errors associated in obtaining this information run characteristically high. An appreciation of how the error develops in this data reduction process will enable more careful control to be maintained for this type of analysis. The following is a list of sources of errors and the extent to which they may influence the resulting acceleration:

1. Time: This quantity is most conveniently obtained from a timing light which marks the edge of the film. Other systems involving a strobe light and a centisecond hand electric clock have been used with less success. The acceleration of the camera film is essentially constant for the short length of film generally analyzed so that the straight line plot of camera speed vs. frame number provides a very accurate means for obtaining the incremental time for each frame. Reproducibility checks of incremental time determinations showed discrepancies varying from 0% to 2.3%. This time error amounts to a shift in the straight line representing the curve for camera frames/sec vs. frame number which in turn represents a corresponding shift in the zero reference for the distance-time and velocity-time plots. Consequently, the slopes, and therefore the magnitudes, of the resulting velocity and acceleration have not been altered. Using the procedures described, there is no significant error introduced in determining time.

2. Distance Measurement: Micrometers facilitate measurement of displacements of the table of the Contour Measuring Projector* to an accuracy of 0.0002 in. However, the grain size of the film's emulsion and other inherent sources of error introduce additional errors of reading. To determine the total error due to film reading, 10 readings of one frame representing the most-defined and 10 of the least-defined frame were made of a film sequence selected for this analysis. From this, two times the standard deviation of the measurements was determined to be of the order of ± 0.0005 in.

In order to test the effect of this maximum error on the decelerations ultimately developed from the distance measurements, a series of frames covering a typical peak deceleration were analyzed. To each of the distances measured, a maximum deviation of $+0.0005$ in. and again -0.0005 in. were applied, thus forming three values of distances for each frame. In differentiating these distances with respect to time, the negative distance was matched with the succeeding positive and this, in turn, with the succeeding negative, so the resulting velocity expressed a maximum error as compared with the velocity determined from the normal readings. This same procedure was again applied to the differentiation of velocity. Although amplified to the extreme, the errors in deceleration did not vary from the observed values more than about 13%. In view of the fact that this 13% error represents the extreme error likely to be encountered, it is not considered excessive.

*A Jones and Lamson Optical Comparator, with special adaptive fixture, has been used with comparable results.

3. Plotting and Curve-Fitting Error: With adequate film speed, enough distance-time data may be obtained with sufficient regularity to enable a visually fitted curve to be drawn with reasonable accuracy. However, in differentiating the distance-time and subsequently the velocity-time curves, unavoidable magnification of previous minor irregularities occurs and the analyst must use considerable judgment in fitting a smooth curve to these plots if excessive errors are to be avoided in the resulting acceleration-time graph. Frequently an increase in the scale of the distance-time plot is indicated. Using automobile collision data, two analysts reduced the same basic distance-time data and obtained the resulting acceleration curves with a peak discrepancy of 8% and an area under curve discrepancy of 4%. Skilled anaysts reducing data on 24 × 36 in. graph paper can secure reproducibility of peak decelerations to within 4%, even for complex deceleration patterns.

A smooth curve (Fig. 4) visually fitted by ten professional members of an engineering staff produced a variation in error from 0.3% to 21.5%, with a mean error of 6%. The most accurate results were produced by those performing this type of analysis most frequently. Even for correct differentiation procedures applied to correct basic data, as high as 100% error has been observed for analysts who used poor curve fitting techniques.

The distance-time plot (Fig. 3) had an adequate number of points with sufficient regularity so that a smooth curve could be visually fitted accurately. This curve provided a slightly more consistent source of distance-time data for velocity analysis by least squares (Graphical-Analytical Solution) than was obtainable by direct differentiation of distance-time data and subsequent application of least squares to velocity-time data (Analytical Solution).

In some types of data reduction, and as is frequently the case for automobile col-

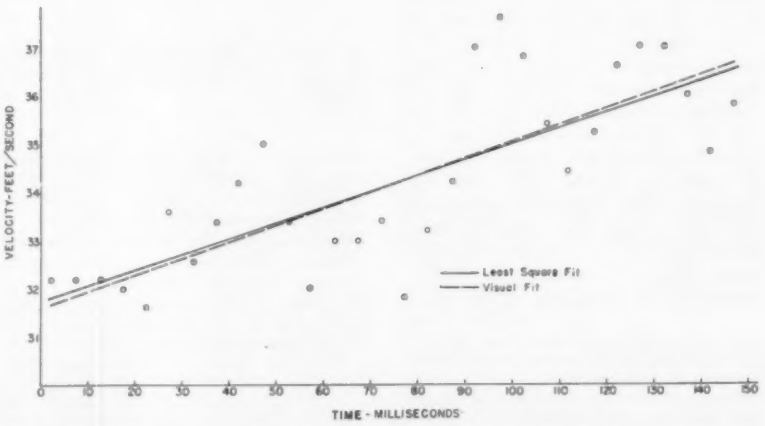


Fig. 4. Velocity-time plot for falling sphere.

lision analyses, curve fitting by method of orthogonal polynomials provides an improvement to the data reduction process. This extension of the least squares method eliminates the trial approximations associated with estimating the order of the equation which fits the curve. Frequently the film speed is fast enough, relative to the speed or change in speed of the object being photographed, that visual curve fitting on large sheets of graph paper provides satisfactory results.

Conclusions

When the film from high-speed photography is subjected to a critical analysis for the purpose of data reduction, an appreciation of the identity and magnitude of error contributions is essential to the securing of results that may be used with a known degree of confidence. This paper has attempted to identify the errors associated with securing acceleration data from high-speed photography. It should be recognized that error can be quantified only for a specific procedure applied to a specific film. The analyst, the tools he has to work with, the scale of his graphical analyses and similar factors influence the overall accuracy of the results. However, the error evaluations made for this paper do serve as a basis for judging their relative magnitudes and the general influence each type of error has on the final acceleration value. The findings of this paper are represented by the following specific conclusions:

1. High-speed photography is an extremely useful tool for recording velocity and acceleration phenomena.

2. When deriving accelerations by micromotion analysis techniques, it is essential to recognize the source of errors introduced during the process of data reduction, and the influence they will have on the accuracy of the final results.

3. The calculated value for the acceleration due to gravity provides a precise reference for calibrating accelerations derived from high-speed photography.

4. The subject tests permitted the determination of error for accelerations derived from high-speed photography. The analyses used and the error they produced were as follows: Graphical, 6%, Graphical-Analytical, 1%, and Analytical, 2%. While, in general, these analyses will bear the same relationship as to order of magnitude, the exact magnitude of error will depend on the analyst, the equipment he uses, and the characteristics of the acceleration being determined.

5. The degree of accuracy of graphical analysis was found to depend principally upon two factors: (a) the choice of a sufficiently large graph scale; (b) the care used in visually fitting the smooth curve to the generally irregular plot.

6. The small errors associated with reading the timing marks on the edge of the film were found not to influence the accuracy of the acceleration calculated by film analysis.

7. At least one auxiliary timing system should be included with high-speed photography. A centisecond timing device having a high contrast, nonglare, large dial connected to a suitable power supply is recommended.

8. Application of poor curve-fitting techniques may introduce errors as high as 100%, even though correct differentiation is applied to correct basic data. The Bausch & Lomb Contour Measuring Projector permits measurements to be made to 0.0002 in. Errors associated with distance measurements, when amplified to the extreme during graphical analysis, can produce an error in the resulting accelerations of as much as 13%.

9. With an adequate film speed, enough distance-time measurements may be made to provide a plot with sufficient regularity to enable a visually fitted distance-time curve to be drawn with reasonable accuracy. Upon differentiation of this curve, the small unavoidable errors of measurement are magnified so that it is frequently necessary to apply analytical curve fitting techniques in order to secure reasonably accurate results. In the subject analyses, analytical curve fitting reduced the errors of the resulting acceleration from 6% to 1%.

10. Reproducibility tests showed that complex acceleration curves, derived by graphical analysis from the same basic data, could have peaks which differ by as much as 8%, and areas under the curves which differ by as much as 4%.

Appendix

g_1 (empirical formula, as function of latitude[1])	= 32.141 ft/sec^2
g_2 (supplied by U.C.L.A. Geophysics)	= 32.139 ft/sec
F_D (air drag on 8-lb, 0.661458-ft dia. sphere[2])	= 0.0047183 lb
F_B (buoyancy of air on sphere)	= 0.0001447 lb
Total decelerating force	= 0.004863 lb
g_3 (net expected acceleration) = $g_1(8.0000-0.004863)/8$	= 32.121 ft/sec^2
g_4 (acceleration measured by analytical method)	= 31.41 ft/sec
	= −2% error
g_5 (acceleration measured from smoothed distance-time curve at 10-msec intervals)	= 32.315 ft/sec^2
	= +0.6% error

Appendix Sources

1. C. D. Hodgman, *Handbook of Chemistry and Physics*, Chemical Rubber Publishing Co., Cleveland, 1953.
2. John K. Vennard, *Elementary Fluid Mechanics*, John Wiley and Sons, New York, 1946.
3. Paul G. Hoel, *Mathematical Statistics*, John Wiley and Sons, New York, 1947, p. 80.

Specialized Lighting and Set Techniques for a Nontheatrical Production

By NICHOLAS WEBSTER

Unusual set treatment and lighting techniques are employed in producing a costume film using many actors and sets. The use of light-control techniques in this filming by Academy Award winner Boris Kaufman in place of conventional optical fades is described. Simple stylized sets further aided in spanning 50 years gracefully in a 30-min film.

COMPROMISES between production values and economics are more severe in the making of most nontheatrical films than in standard theater-type pictures because of limited budgets. These budget limitations often lead toward production formulas which have not only become trite, but which make it extremely difficult to provide sufficient directorial and performing skill to create the necessary dramatic effects. This paper describes and illustrates a successful nontheatrical conjunction with accurate and well-controlled set-lighting procedure, resulting in high dramatic effect with a relatively low budget.

The picture *Within Man's Power*, produced and directed by the writer for the National Tuberculosis Association, told the story of man's long and unceasing fight to wipe out TB. The script, written by Ted Murkland, used a cast of more than sixty characters and an abundance of sets which added greatly to the economic problem and demanded careful preplanning.

Presented on April 19, 1955, at the Society's Convention at Chicago by Nicholas Webster, producer-director, Nicholas Webster Motion Pictures, 105 Eleventh St., S.E., Washington, D.C.; sponsored by Capital Film Laboratories, Inc., 1905 Fairview Ave., N.E., Washington 2, D.C.
(This paper was received January 16, 1956.)

With Boris Kaufman, A.S.C., as Director of Cinematography we worked out lighting techniques which dispensed with conventional optical fades. By fading in and out with set illumination we were able, in some cases, to provide in a single set the illusion of multiple locations and create sequences which would have otherwise required many sets.

With a mutual understanding as to just what we could do with lighting control it was possible to greatly enhance the dramatic sweep of the film with extremely stylized sets in which the barest essentials were used to suggest location and mood.

Table I is a partial list of the equipment which was operated by a four-man electrical crew. By Hollywood standards there was nothing impressive about the physical equipment used, although the variety was greater than that of most nontheatrical productions.

The equipment was operated from the stage's permanent service of nine 60-amp circuits, with the exception of two dimmer boards which were supplied from a 400-amp auxiliary switch. The total load on the stage was 265 amp per phase on a four-wire, three-phase 208/120-v system.

Some of the scenes required as many as 18 light changes and, as the timing had to be precise, hours of rehearsal were necessary before the actual shooting.

Table I. Some of the Equipment Used.

No. units	
1	Dimmer board—7–2,000-w, 2–1,000-w plates
1	Dimmer board—6–1,500-w dimmers
2	Auxiliary dimmers—2,000-w each
2	Auxiliary dimmers—1,000-w each
1	Auxiliary 550-w autotransformer for the obie light
1	5-kw Senior spot
16	2-kw Junior spots
18	750-w spots
4	2-kw double broads
4	750-w single broads
4	300-w spots
2	100-w inkies
1	600-w obie light for the camera
1	Wind effect machine

One scene, which plays on the screen for three minutes, required five hours of set-up and lighting rehearsals.

In the scene illustrated in Fig. 1* accurate control of lighting made it possible to depict the editorial department of a large newspaper, from the editor-in-chief down to a columnist, in one set and with a single take that lasted three minutes.

Because we could fade in or out with our lights as desired, it was not necessary to build an elaborate newspaper office on the stage. The set consisted entirely of three, black-draped, boxlike platforms, the second and third a little higher than the preceding one.

Symbolically, on the top platform we

* All illustrations are from the film *Within Man's Power*. The sets were designed by James Waring.

Fig. 1. Scene showing newspaper office (impressionist set). Roberta Robinson plays Emily Bissell who started the Christmas seal drive in America.

Fig. 2. Scene from a stylized set of the production, using only the necessary staging and props. The child character is Judy Hall as Ann Connett.

Fig. 3. Scene with Chris Gampell as Dr. Trudeau and Jim Ward as a fisherman friend.

Fig. 4. Joseph Anthony portrays Dr. Flick. Simplicity of set kept all interest on the character portrayals.

placed the desk of the editor-in-chief; on the next one below it, the desk of the managing editor; and on the bottom one, the reporter. Our moves from one "office" to the next, and from one character to another, were made with lights, as well as with camera movement on a dolly.

Boris Kaufman built up each scene as an artist creates a painting on canvas. He started with absolute blackness and as each scene faded in he used lights as brush strokes to "paint" in such detail as he needed to achieve just the desired result, and no more.

At the end of each sequence all the lights faded to a complete blackout making it possible to reduce every scene visually to the barest essentials. This simple approach applied not only to lighting, but also the the sets themselves.

The opening and closing modern scenes of *Within Man's Power* are laid against a conventional indoor background, but the rest of the film consists of a series of highly stylized period sets, in which the scene is suggested, rather than depicted in detail, by the scenery and props.

A room in a Victorian period house (Fig. 2), for instance, appears as a white doorway-and-window-frame against a black velvet curtain. The only props were a bed, a chair, a table and an ornate gas chandelier. There was nothing superfluous in the set itself to distract audience attention from the central theme of the story.

The special techniques evolved for this film raised a number of problems not usually encountered in film making.

To make the background complete and to avoid the illusion of a line across the screen at the point where the velvet drapes ended, we painted the floor of the stage gray and along the edges graduated it into jet black with a paint sprayer. As a result our actors and props appear on the screen to be suspended in space. In many scenes characters were faded out separately to heighten the drama of the situation.

Figure 3 creates the impression of a cabin in the woods. Glycerin was sprinkled on the real pine trees to make them sparkle. The sound of crickets added to the illusion. Figure 4 shows how properly controlled light enhances the mood of the scene and places emphasis on the characters.

Another photographic problem was posed in a scene in which the script called for an exterior shot sandwiched among the highly stylized interiors. The exterior in question was a shot of a group of mourners walking down a cobblestoned path in a cemetery. This was solved by placing the camera on the ground and shooting through a box covered with scrim cut into irregular patterns. The mood of the finished scene was exactly that established in the black velvet interiors—low key and heavy shadows—including the effect of a black border.

Within Man's Power was produced on the sound stage of Capital Film Laboratories, Washington, D.C. and was exhibited from coast to coast in connection with the 50th-Year Anniversary of the National Tuberculosis Association. It is a striking example of the manner in which technicians can use suggestive artificial devices to enable men like Boris Kaufman and his crew to translate to the screen the exact mood required by the director.

International Standardization

By HENRY KOGEL

Report on Second Meeting of ISO/TC 36—Cinematography

THE FIRST meeting of the International Standards Organization Technical Committee on Cinematography, ISO/TC 36, was held in New York City in June 1952. The accomplishments were appreciable, agreement having been reached to start the processing of 22 Draft ISO Proposals. (See the October 1952 *Journal* for the detailed report of that meeting.)

The second meeting of ISO/TC 36 was held June 11–16, 1955, in Stockholm and if anything, this meeting was even more successful than the first. Based on the previous experience, five working days were scheduled rather than three; there was a greater participation of the member nations; the existing proposed standards were reviewed and revised where necessary; new standards proposals were initiated; and Working Groups were established to continue discussion of the unresolved questions and to draft additional proposals.

A general review of the deliberations of the Stockholm meeting has been presented by D. R. White, head of the U.S. Delegation, at the Society's 78th Convention at Lake Placid, N.Y., and has been published in the November 1955 *Journal*. It is the intent of this report to present a more detailed picture of the meeting.

Participants

Ten nations, with a total of 48 delegates, participated in this meeting. The participants are listed in Appendix 1.

Status of 22 Draft ISO Recommendations

The first order of business, after the opening remarks, was a review of the status of the 22 standards initiated in 1952. The secretariat submitted a report which indicated that 10 of these standards were proceeding satisfactorily without criticism and that the other 12 required further consideration. Three ad hoc Working Groups were appointed to study 11 of these standards. The twelfth item, on safety film, was left for a more detailed analysis at a later time. Appendix 2 lists the number and title of the standards in each category and the composition of the Working Groups established to work on them.

A report prepared by Henry Kogel, SMPTE Staff Engineer, Secretary, ASA Sectional Committee PH22, and Technical Secretary, ISO/TC 36.

Agenda

An agenda consisting of six generalized concepts was approved as listed below:

1. Cutting and Perforating Dimensions for Motion-Picture Film
2. Definition and Markings of Motion-Picture Safety Film
3. Screen Luminance (Brightness)
4. Location and Dimensions of Magnetic Sound Records
5. Reproduce Characteristics of Magnetic Sound Records
6. Wide-Screen Motion Pictures

Drafting Committee on Resolutions

One marked variation from the procedures of the 1952 meeting was the appointment, at the outset, of a drafting committee charged to draft in resolution form the tentative agreements reached so that the final agreements of this meeting would be clear and unmistakable. This committee consisted of U.K. (Griffiths) Chairman, Belgium (Spinnox), France (Vivié), Germany (Wohlrab), Sweden (Smith).

Ad Hoc Working Groups

The three ad hoc Working Groups, appointed to review the standards in process, did a fine job and as a by-product demonstrated the advantage of this procedural form for undertaking all the agenda items. Ad hoc Working Groups were thereupon appointed for the consideration of each agenda item. The list of these Working Groups and their composition is given in Appendix 3.

Adopted Resolutions

Each Working Group prepared a report of its deliberations which was reviewed by the committee sitting in full session. Upon acceptance, these reports were used by the Resolutions Committee as a basis for preparing the draft resolutions. A total of 15 Resolutions were adopted in the last two days of this meeting, June 15 and 16, 1955. These 15 Resolutions are an embodiment, as it were, of the labor of those participating in this five-day meeting and represent the consensus of the meeting. The remainder of this report is therefore directed toward the presentation of this material in a clear and concise form.

1. *RESOLVED that*

a. Draft ISO Recommendation #71, Cutting and Perforating Dimensions for 35mm Motion-Picture Positive Raw Stock, be withdrawn.

b. A Working Group be appointed to prepare a comprehensive Draft ISO Proposal relating to the 35mm film specified in the American Standards listed below.

c. The constitution of this Working Group be U.K. (chairman), Belgium, France, Germany, Sweden, U.S.A., U.S.S.R.

Schedule

(1) PH22.1-1953, Dimensions for 35mm Motion-Picture Film Alternate Standards for Either Positive or Negative Raw Stock
(2) Z22.34-1949, Cutting and Perforating Dimensions for 35mm Motion-Picture Negative Raw Stock
(3) PH22.36-1954, Dimensions for 35mm Motion-Picture Positive Raw Stock
(4) PH22.93-1953, Dimensions for 35mm Motion-Picture Short-Pitch Negative Film
(5) PH22.102 (Proposed), 35mm Motion-Picture Alternate Standard for Positive Raw Stock

2. *RESOLVED that*

The Secretariat prepare a Draft ISO Proposal for the screen luminance of matte screens used in the projection of 35mm film, this proposal to include the following concepts and values:

a. Luminance values be expressed in nit units.

b. Luminance level be 35 nit + 15 − 5 (10.1 ft-L + 4.5 − 1.3). These values be valid for measurements at the center of the screen taken from any point in the theater.

c. The minimum value of luminance at the edges of the screen be 65% of the value of luminance at the center of the screen. The points of measurement be determined in the horizontal axis at a distance from the edges equal to 5% of the width of the screen.

d. Measurement of the luminance be with a photometer having an acceptance angle not greater than 2° and a spectral sensitivity equivalent to that of a normal observer as specified by the C.I.E. in 1931.

3. *RESOLVED that*

a. A Working Group be established to study questions related to the luminance of metallized screens for the projection of 35mm film and to prepare a Draft ISO Proposal.

b. The constitution of this Working Group be France (chairman), Germany, U.K., U.S.A.

4. *RESOLVED that*

a. A Working Group be appointed to prepare a Draft ISO Proposal specifying the reproduce characteristics of magnetic sound on perforated film.

b. The constitution of this Working Group be U.S.A. (chairman), France, Germany, Netherlands, Sweden, U.K.

c. The Secretariat prepare a preliminary proposal for use by this Working Group to include the following specifications:

(1) For 35mm fully coated film with tracks "100 mils" or wider, A_1 is the basic curve and may be used with or without de-emphasis in accordance with B_1, B_2 or both, at the option of the recording studio. Provision should be made for marking or otherwise identifying film using a characteristic other than A_1.

(2) For 35mm film with soundtracks having a width of "50 mils" or less the replay chain is to have a characteristic which is the sum of curves A_1, B_1 and B_2.

(3) For 16mm fully coated film with tracks "100 mils" and wider, A_2 is the basic curve and may be used with or without de-emphasis in accordance with B_1, B_2 or both, at the option of the recording studio. Provision should be made for marking or otherwise identifying film using a characteristic other than A_2.

(4) For 16mm films having a magnetic stripe on the same film as the picture, the replay chain is to have a characteristic which is the sum of A_2, B_1 and B_2.

The Following Tabulation of Values Identifies the Curves Referred to Above (Tabular Data in db Units):

f c/s	50	100	200	500	1000	1600	2000	4500	5000	10000
A_1	39.1	33.1	27.0	19.1	13.3		7.9	+3	+2.6	+0.8
A_2	30.1	24.1	18.1	10.5	5.5	+3	2.1		0.4	0.1
B_1	−6.0	−3.5	−1.3	−0.1	0		0		0	0
B_2	0	0	0	0	0		0		−1	−4

d. The Working Group study at an appropriate time the following items for further standardization efforts and arrange for the exchange of experimental data leading to such standardization:

(1) Magnetic replay characteristics for 8mm film.

(2) Establishment of standard methods for the absolute measurement of reference level of magnetic sound records.

(3) Reduction of the number of different standard replay characteristics for fully coated 35mm and 16mm film.

5. *RESOLVED that*

a. Draft ISO Recommendations #69 and 70 be amended as scheduled below.

b. The ISO General Secretariat circulate the revised Draft Recommendations to all member countries for approval.

Schedule of Amendments

(1) Dimension E be changed from 0.91 mm (0.036 in.) to 0.90 mm (0.0355 in.).

(2) Tolerance on dimension A in No. 69 be corrected from ±0.01 in. to ±0.001 in.

(3) Tolerance on mm values for dimension A be amended to ±0.025 mm.

(4) A footnote relating to dimensions A and E be added as follows:
These dimensions are for low-shrink film base as defined in Appendix 1. For film base with higher shrinkage characteristics A shall be 15.98 mm ± 0.025 (0.629 in. ± 0.001) and E shall be 0.91 mm ± 0.05 (0.036 in. ± 0.002).

(5) An appendix be inserted as follows:
For the purpose of this specification, low-shrink film base is film base which, when coated with emulsion and any other normal coating treatment, perforated, kept in the manufacturer's sealed container for six months, exposed, processed and stored exposed to air having a temperature of 18 C to 24 C and a relative humidity of 50% to 60% for not more than 30 days, and measured under like conditions of temperature and humidity, shall have shrunk not more than 0.2% from its original dimension at the time of perforating.

6. *RESOLVED that*

a. Draft ISO Recommendation #72 be amended as scheduled below.

b. The ISO General Secretariat circulate the revised Draft Recommendation to all member countries for approval.

Schedule of Amendments

(1) The tolerance of dimension F be increased to ±0.05 mm (±0.002 in.) to bring it into conformity with the tolerance on the related dimension D.

(2) In the diagram, those dimensions and notes which relate to the area scanned by the reproducer be lowered so that they are separated from the illustrations above, because the center lines represented by the letters D and F are not identical.

7. *RESOLVED that*

Draft ISO Recommendation #76 be withdrawn to be replaced by a more comprehensive Draft ISO Proposal as provided by Resolution 11.

8. *RESOLVED that*

a. Draft ISO Recommendations #77, 78, 81, 82 be amended as scheduled below.

b. The ISO General Secretariat circulate the revised Draft Recommendations to all member countries for approval.

Schedule of Amendments

No. 77

(1) Delete the dimensions and indications referring to *a* and *b* in the diagram.

(2) Insert "max" after value for dimension E.

(3) Change R from 0.8 mm max (0.03 in. max) to 0.15 mm max (0.006 in. max).

(4) Add subscript p (projector) so that dimension C is indicated as C_p.

(5) To clarify dimension D, add an editorial note explaining that D is the distance between lines 1 and 5.

No. 78

(1) Amend the note referring to full hole pilot pins to read: "If full hole pilot pins are used they should engage with this row of perforations."

(2) Add subscript c (camera) so that dimension C is indicated as C_c.

Nos. 81 and 82

(1) Delete the figure on the left of the diagram.

(2) Complete the diagram on the right by full lines for the right-side edge and for the perforations of the film and by dotted lines for the complete image contours above and below the principal image.

9. *RESOLVED that*

a. A Working Group be appointed to revise Draft ISO Recommendations #79 and 80, taking note of the suggested revisions given below.

b. The constitution of this Working Group be Belgium (chairman), France, Sweden, U.K., U.S.A.

c. The ISO General Secretariat circulate the revised Draft Recommendations to all member countries for approval.

Suggested Revisions

No. 79

(1) Correct typographical error in English title so that the phrase "projected image area" becomes "image produced by camera aperture."

(2) To the righthand edge of the film, add the designation "reference edge."

(3) If (2) is adopted, transfer dimension C from the centerline through the optical axis of the camera to the reference edge at the righthand (perforated) side of the film.

(4) Change dimension B to 7.37 mm + 0.23 − 0, 0.29 in. + 0.009 − 0.

(5) Delete the figure on the lefthand side of the diagram.

(6) Change par. 1 of Note 1 to read as follows:
Dimensions A, B and R apply to the size of the image at the plane of the emulsion; the camera aperture has to be slightly smaller. The exact amount of this difference depends on the lens used (whether of short focal length and/or large diameter) and on the separation of the emulsion and the aperture plate. This separation should be no larger than is necessary to preclude scratching of the film.

(7) Alter par. 2 of Note 1 to read as follows:
The dimension B of a 16mm image obtained by optical reduction at a ratio of 2.15/1 from a 35mm negative will be 7.44 mm + 0.10 − 0 when the width of the image is 5.11 mm + 0.20 − 0.

No. 80

(1) Transfer dimension C from the centerline through the optical axis of the camera to the reference edge at the righthand (perforated) side of the film.
(2) Delete the figure on the lefthand side of the diagram.
(3) Delete the dimensions and indications referring to *a* and *b* in the diagram.

10. *RESOLVED that*

a. Draft ISO Recommendation #83 be withdrawn.
b. A Working Group be appointed to prepare a Draft ISO Proposal on Definition and Marking of Motion-Picture Safety Film.
c. The constitution of this Working Group be Belgium (chairman), France, Germany, Italy, U.K., U.S.A.
d. The Draft ISO Proposal be based upon ISO/TC 42 (USA-1) 32, Specification For Safety Photographic Film, PH1.25, with the revisions suggested below.
e. The Secretariat circulate the Draft ISO Proposal to the members of TC 36.

Suggested Revisions

(1) Add the following footnote to par. 1.1: "This specification excludes fully coated magnetic films."
(2) In par. 3, change the thickness from 0.8 mm to 0.08 mm.
(3) Consider the method of measurement specified in British Standard 850:1955 as an alternative method to the one specified in par. 3.2.
(4) In par. 3.2.1, substitute for "16mm" (3rd line) the phrase, "narrower than 35mm" and replace the 4th line with "and its full width may be tested."
(5) Change par. 4 as follows:
(a) Insert "nitrate" before "nitrogen" in the title of the paragraph and in the definition.
(b) Complete the definition by adding this sentence: "The total nitrate nitrogen content of the complete film should not be more than this limit."
(c) Delete the footnote and the reference to the U.S. formula.
(d) Include the Schulze Tieman test (B.S. 850) as an alternative method.
(e) Delete the specification under the heading of "Marking," par. 6, and replace with "Safety film should be suitably marked as such."

11. *RESOLVED that*

The Secretariat prepare four Draft ISO Proposals as scheduled below:

a. 4-Track Magnetic Recording on Fully Coated 35mm Film. (See Appendix 4)
(1) Dimension the magnetic heads as a group and give only one dimension from each group to the edge of the film.
(2) Locate this system of dimensioning between the design of the film and the indication of the magnetic heads.
(3) Specify the width of the recording heads rather than the sound records.

b. 3-Track Magnetic Recording on Fully Coated 35mm Film. (See Appendix 5)
(1) The scope of this proposal is to include single- and double-track recording on 35mm film as well as single-track recording on 17½mm film.
(2) The method of dimensioning is to be the same as indicated for the 4-track proposal above.
(3) Use the text of Draft ISO Recommendation #76 as the basis for this proposal.
(4) Change the last line of the text to read, "track #3" instead of "#2."

c. Magnetic Coating of 16mm Film Perforated Along Both Edges. (See Appendix 6)
(1) Use Proposed American Standard, PH22.101, Magnetic Coating of 16mm Film Perforated Along Both Edges, as the basis for this proposal.
(2) Indicate the dimensions in letters and prepare a table of values in millimeters and inches.

d. Magnetic Recording on Fully Coated 16mm Film Perforated Along One or Both Edges. (See Appendix 7)
(1) If film is perforated along both edges, use the German Proposal 15 656 to specify the sound record in the center of the film.
(2) If the film is perforated along one edge only, specify the center sound record as in (1) above as well as an optional sound record on the nonperforated side.
(3) Inasmuch as the dimension of the optional track on the nonperforated side is in question, the Secretariat is to delay the circulation of this proposal until this question is resolved.
(4) The magnetic coating is on the side of the film toward the lamp of a projector arranged for direct projection on a reflection-type screen.

12. *RESOLVED that*

a. A Working Group be appointed to review all questions relating to the location and dimensions of magnetic sound records on perforated film.
b. The constitution of this Working Group be Germany (chairman), France, Sweden, U.K., U.S.A.
c. This Working Group prepare a Draft ISO Proposal on the magnetic striping of 16mm motion-picture film containing picture and sound. (See Appendix 8)
d. American Standard PH22.87-1953 be the basis for this Draft ISO Proposal but modified as follows:
(1) Locate the sound 28 frames ahead of the corresponding picture.
(2) Specify an optional balance stripe of magnetic or another material of the same thickness outside the perforation.
(3) Review the width of the stripe since 100 mils has been questioned as being too large. (It was stated that the clearance between the stripe and the edge of the picture gate in the camera becomes too small when the tolerances add in an unfavorable direction.)

13. *RESOLVED that*

a. The Secretariat prepare a Draft ISO Proposal for the maximum image ratio and the location of the image for the projection of wide-screen pictures from normal format images (no lateral compression).
b. This proposal specify the following:
(1) A maximum aspect ratio of 1.85:1.
(2) The upper edge of the projector aperture be 1.7 mm (0.067 in.) below the upper edge (in the direction of film travel) of the printed image on the film.

14. *RESOLVED that*

a. The Secretariat prepare a Draft ISO Proposal based on American Standard PH22.17-1954, Dimensions for 8mm Motion-Picture Film and containing the amendments scheduled below.
b. This proposal be then circulated to the Working Group established under Resolution #1 for this Group to incorporate an appendix defining low-shrink film base and to establish a tolerance for dimension E.

Schedule of Amendments

(1) Delete "negative and positive" from line reading: "Those dimensions apply — perforating."
(2) Add "in raw stock manufacture" to the caption "single width after slitting."
(3) Change dimension H from 7.98 to 7.975 mm.
(4) Change the tolerance on dimension A from ±0.03 to ±0.025 mm.
(5) Change dimension A to 15.95 mm (0.628 in.).
(6) Change dimension E to 0.90 mm (0.0355 in.).
(7) Add the following footnote:
These dimensions are for low-shrink film base as defined in the appendix. For film base with higher shrinkage characteristics A shall be 15.98 mm ± 0.025 (0.629 in. ± 0.001) and E shall be 0.91 mm ± 0.05 (0.036 in. ± 0.002).

15. *RESOLVED that*

a. A Working Group be appointed to prepare Draft ISO Proposals on wide-screen motion pictures, these proposals to include the position and dimensions of picture area and sound records.
b. The composition of this Working Group be Sweden (chairman), France, Germany, Italy, U.K., U.S.A.
c. This Working Group consider as its first order of business a proposal for release prints with one optical and two magnetic sound records.

Addendum

Subsequent to the meeting, the Secretariat assigned letter symbols to the continuing Working Groups appointed per the above resolutions as a convenient means of referring to these Working Groups. These are listed below for ready reference:

Resolution	*Working Group*	*Subject*
1	A	Film Dimensions
3	B	Luminance of Screens
4	C	Reproduction Characteristics of Magnetic Sound on Perforated Film
9	D	Image Areas for 16mm Projector and Camera Apertures
10	E	Definition and Marking of Safety Motion-Picture Film
12	F	Perforated Films with Magnetic Striping
15	G	Wide-Screen Pictures

In January 1956, the U.S.S.R. asked the Secretariat to add her as a member of all the newly organized Working Groups. The Secretariat has complied with this request and all the Working Groups have been notified of this addition.

Appendix 1. Delegates Participating in the Meeting.

BELGIUM
Raymond Spinnox

CZECHOSLOVAKIA
František Vymyslický

FRANCE
Robert Alla
Albert Barbier-St. Hilaire
Joseph Cordonnier
Louis Didiée
Jean Ferrière
Robert G. Ivonnet
Henri Renard
Jean Vivié

GERMANY
Werner Behrendt
Karl-Otto Freilinghaus
Karl-Erik Gondesen
Herman Heidenreich
Arthur Laufmann
Paul Lindau
L. Mayer
Albert Meister
Kurt Neitzel
Armin Sonnenfeld
H. Tümmel
Fritz Wilken
Hans-Christoph Wohlrab

ITALY
Clinio Cuccolini
Libero Innamorati

NETHERLANDS
N. A. J. Voorhoeve

SWEDEN
Arvid Ahlin
K. G. Helmer Bäckström
Harry Dahlqvist
Stellan Dahlstedt
Harry Enequist
Sixten Lingheim
Holger Marcus
Kai Smith

UNION OF SOVIET SOCIALIST REPUBLICS
K. Spasskij
V. Volodin

UNITED KINGDOM
G. J. Craig
H. L. Griffiths
Leslie Knopp
O. K. Kolb

UNITED STATES
W. F. Kelley
Motion Picture Research Council
Marion E. Russell
Eastman Kodak Co.
Malcolm G. Townsley
Bell & Howell Co.
Deane R. White
E. I. du Pont de Nemours & Co.

UNITED STATES (Secretariat)
Axel G. Jensen
Bell Telephone Laboratories
J. W. McNair
American Standards Association
Boyce Nemec
Society of Motion Picture and Television Engineers

Appendix 2. Ten Draft ISO Recommendations Processed Without Criticism.

Related Am. Stds.	*Draft ISO Rec. No.*	*Title*
PH22.2-1954	60	Emulsion and Sound Record Positions in Camera for 35mm Sound Motion-Picture Film
.3-1954	61	Emulsion and Sound Record Positions in Projector for 35mm Sound Motion-Picture Film
.9-1956	62	Emulsion Position in Camera for 16mm Silent Motion-Picture Film
.10-1956	63	Emulsion Position in Projector for Direct Front Projection of 16mm Silent Motion-Picture Film
.15-1955	64	Emulsion and Sound Record Positions in Camera for 16mm Sound Motion-Picture Film
.21-1953	65	Emulison Position in Camera for 8mm Silent Motion-Picture Film
.22-1953	66	Emulsion Position in Projector for Direct Front Projection of 8mm Silent Motion-Picture Film
.36-1954	71	Cutting and Perforating Dimensions for 35mm Motion-Picture Positive Raw Stock
.69-1953	74	Sound Records and Scanning Area of Double-Width Push-Pull Sound Prints, Normal Centerline Type
.70-1953	75	Sound Records and Scanning Area of Double-Width Push-Pull Sound Prints, Offset Centerline Type
Twelve Draft ISO Recommendations Requiring Further Consideration.		
.5-1953	69	Cutting and Perforating Dimensions for 16mm Silent Motion-Picture Negative and Positive Raw Stock
.12-1953	70	Cutting and Perforating Dimensions for 16mm Sound Motion-Picture Negative and Positive Raw Stock
.40-1950	72	Sound Records and Scanning Area of 35mm Sound Motion-Picture Prints
.41-1946	73	Sound Records and Scanning Area of 16mm Sound Motion-Picture Prints
.86-1953	76	Magnetic Sound Tracks on 35mm and 17.5mm Motion-Picture Film
.58-1954	77	35mm Film Projected Image Area
.59-1954	78	35mm Film Image Produced by Camera Aperture
.7-1950	79	16mm Film Image Produced by Camera Aperture
.8-1950	80	16mm Film Projected Image Area
.19-1950	81	8mm Film Image Produced by Camera Aperture
.20-1950	82	8mm Film Projected Image Area
.31-1946	83	Definition for Motion-Picture Safety Film

Three Ad Hoc Working Groups.

Film Dimensions — On Draft ISO Recommendations #69 and 70
U.K. (Craig) Chairman, France (Renard), Sweden (Dahlstedt), U.S.A. (Russell)
Sound Records — On Draft ISO Recommendations #72, 73 and 76
Germany (Tümmel) Chairman, France (Ivonnet), U.K. (Kolb), U.S.A. (Townsley)
Film Image Area — On Draft ISO Recommendations #77–82
Belgium (Spinnox) Chairman, France (Alla), Sweden (Enequist), U.K. (Knopp), U.S.A. (Kelley)

Appendix 3. Ad Hoc Working Groups.

Agenda Item	*Composition*	
	Chairman	*Members*
1. Cutting and Perforating Dimensions for Motion-Picture Film	U.K. (Craig)	Belgium (Spinnox), France (Didiée), Germany (Behrendt), U.S.A. (White)
2. Definition and Markings of Motion-Picture Safety Film	Belgium (Spinnox)	France (Didiée), Germany (Behrendt), Italy (Cuccolini), U.K. (Knopp), U.S.A. (Russell)
3. Screen Luminance	France (Alla)	Germany (Wilken), U.K. (Knopp), U.S.A. (Kelley)
4. Location and Dimensions of Magnetic Sound Records	Germany (Wohlrab)	France (Ivonnet), Sweden (Smith), U.K. (Kolb), U.S.A. (Kelley)
5. Reproduction Characteristics of Magnetic Sound Records	U.S.A. (Townsley)	France (Ivonnet), Germany (Gondesen), Sweden (Marcus), U.K. (Kolb)
6. Wide-Screen Motion Pictures	Sweden (Dahlstedt)	Sweden (Enequist), France (Alla, Cordonnier, Vivié), Germany (Heidenreich, Tummel), Italy (Innamorati), U.K. (Griffiths), U.S.A. (Kelley)

Appendix 4. Four Magnetic Sound Records on 35mm Motion-Picture Film.

1. SCOPE

1.1 This standard specifies the location and dimensions of four magnetic sound records on fully coated 35mm motion-picture film.

2. SOUND RECORDS

2.1 The four sound records shall be recorded in accordance with the diagram and table of dimensions provided.

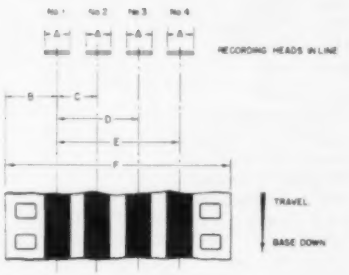
3. FILM BASE

3.1 The film base shall be of the low-shrinkage, safety type.

3.2 With the direction of travel as shown in the diagram the magnetic material is coated on the upper side of the film base.

3.3 The cutting and perforating dimensions of the film shall be those specified in Draft ISO Recommendation No. 71, Cutting and Perforating Dimensions for 35mm Motion-Picture Positive Raw Stock, or the latest revision thereof.

Dimension	*Millimeters*	*Inches*
A	$3.8\ ^{+0.1}_{-0.0}$	$0.150\ ^{+0.004}_{-0.000}$
B	7.9 ± 0.05	0.314 ± 0.002
C	6.4 ± 0.05	0.250 ± 0.002
D	12.8 ± 0.05	0.500 ± 0.002
E	19.2 ± 0.05	0.750 ± 0.002
F	35 nominal	1.378 nominal



Appendix 5. Three Magnetic Sound Records on 35mm Motion-Picture Film; One Magnetic Sound Record on 17½mm Motion-Picture Film.

1. SCOPE

1.1 This standard specifies the location and dimensions of up to three magnetic sound records on 35mm motion-picture film and of one sound record on 17½mm motion-picture film.

2. DIMENSIONS

2.1 The dimensions shall be as specified in the diagram and table provided.

3. PREFERRED TRACK POSITION

3.1 Track No. 1 is the preferred position for single-track recording on 35mm film and is the standard position for sound recording on 17½mm film. When the film is turned end for end, track No. 3 occupies the position of track No. 1.

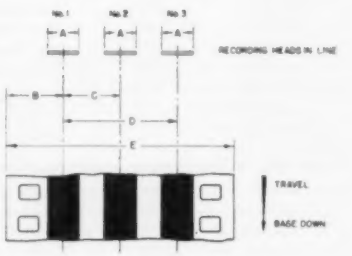
4. FILM BASE

4.1 The film base shall be of the low-shrinkage, safety type.

4.2 With the direction of travel as shown in the diagram the magnetic material is coated on the upper side of the film base.

4.3 The cutting and perforating dimensions of the film shall be those specified in Draft ISO Recommendation No. 71, Cutting and Perforating Dimensions for 35mm Motion-Picture Positive Raw Stock, or the latest revision thereof.

Dimension	*Millimeters*	*Inches*
A	$5.0\ ^{+0.1}_{-0.0}$	$0.200\ ^{+0.004}_{-0.000}$
B	8.6 ± 0.05	0.339 ± 0.002
C	8.9 ± 0.05	0.350 ± 0.002
D	17.8 ± 0.05	0.700 ± 0.002
E	35 nominal	1.378 nominal



Appendix 6. Magnetic Striping of 16mm Film Perforated Along Both Edges.

1. SCOPE

1.1 This standard specifies the location and dimensions of the magnetic coating material when applied to 16mm motion-picture film with perforations along both edges to be used for both picture and sound.

2. DIMENSIONS

2.1 The dimensions shall be as given in the diagram and table provided.

2.2 The magnetic coating is on the side of the film toward the lamp on a projector arranged for direct projection on a reflection-type screen.

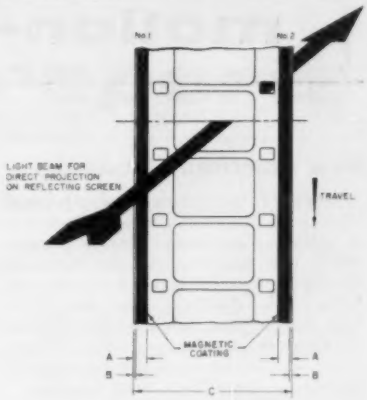
3. SOUND RECORD

3.1 The sound record shall be placed on track No. 1.

3.2 Track No. 2 is used as a balance stripe.

Note: The balance stripe may be used for a second sound record.

Dimension	*Millimeters*	*Inches*
A	$0.80 \begin{smallmatrix}+0.00\\-0.10\end{smallmatrix}$	$0.031 \begin{smallmatrix}+0.000\\-0.003\end{smallmatrix}$
B	0.05 max	0.002 max
C	16 nominal	0.628 nominal



Appendix 7. Magnetic Sound Records on Fully Coated 16mm Film Perforated Along One or Both Edges.

1. SCOPE

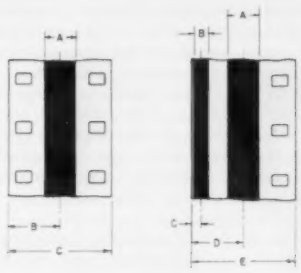
1.1 This standard specifies the location and dimensions of the magnetic sound record/records on fully coated 16mm motion-picture film with perforations along either one or both edges.

2. DIMENSIONS

2.1 The dimensions shall be as given in the diagram and table provided.

2.2 The magnetic coating is on the side of the film toward the lamp of a projector arranged for direct projection on a reflection-type screen.

Dimension	*Millimeters*	*Inches*
A	$5.00 \begin{smallmatrix}+0.10\\-0.00\end{smallmatrix}$	$0.197 \begin{smallmatrix}+0.004\\-0.000\end{smallmatrix}$
B	8.00 ± 0.05	0.315 ± 0.002
C	16 nominal	0.628 nominal
D	$2.60 \begin{smallmatrix}+0.10\\-0.00\end{smallmatrix}$	$0.102 \begin{smallmatrix}+0.004\\-0.000\end{smallmatrix}$
E	1.30 ± 0.05	0.051 ± 0.002



Appendix 8. Magnetic Striping of 16mm Motion-Picture Film Perforated Along One Edge.

1. SCOPE

1.1 This standard specifies the location and dimensions of the magnetic stripes on 16mm motion-picture film with perforations along one edge to be used for both picture and sound.

2. DIMENSIONS

2.1 The dimensions shall be as given in the diagram and table provided.

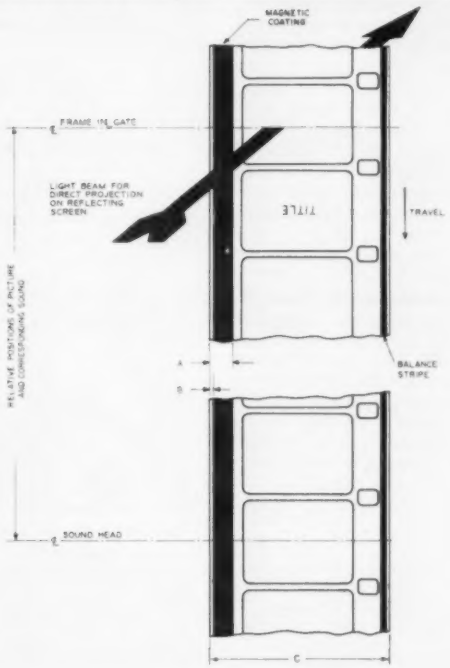
2.1 The magnetic coating is on the side of the film toward the lamp of a projector arranged for direct projection on a reflection-type screen.

3. PICTURE – SOUND SEPARATION

3.1 The magnetic sound record on the film shall precede the center of the corresponding picture by a distance of 28 frames.

Note: The balance stripe is optional and may be a magnetic coating or another material of the same thickness.

Dimensions	*Millimeters*	*Inches*
A	$2.5 \begin{smallmatrix}+0.1\\-0.0\end{smallmatrix}$	$0.100 \begin{smallmatrix}+0.005\\-0.000\end{smallmatrix}$
B	$0.1 \begin{smallmatrix}+0.0\\-0.1\end{smallmatrix}$	$0.005 \begin{smallmatrix}+0.000\\-0.005\end{smallmatrix}$
C	16 nominal	0.628 nominal



motion-picture standards

New American Standard

Published here is a new American Standard, PH22.100, Screen Brightness of 16mm Laboratory Review Rooms which was approved by the American Standards Association on December 30, 1955. This standard does not differ from the proposal published for trial and comment in the January 1955 Journal, where a summary of its development will be found.—*Henry Kogel*, Staff Engineer

American Standard

Screen Brightness of 16mm Laboratory Review Rooms

ASA
Reg. U. S. Pat. Off.
PH22.100-1955
*UDC 778.5

1. Scope

1.1 This standard specifies the brightness of screens used in the projection of 16mm motion-picture prints in laboratory review rooms.

2. Screen Brightness

2.1 The brightness at the center of a screen for viewing 16mm motion pictures in laboratory review rooms shall be 10 ± 2 ft-L when the projector is running with no film in the gate.

Approved December 30, 1955, by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers
*Universal Decimal Classification

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70 East Forty-fifth Street, New York 17, N. Y.

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Price, 25 Cents

Standards Subscription Service

Engineers who do design or maintenance work will welcome the Society's new Standards Subscription Service which gives them, for a single annual fee, copies of all American Standards sponsored during the year by SMPTE. These Standards are the final versions as approved and printed by the American Standards Association, following publication in this *Journal*. Copies of all standards issued during the preceding three months will be sent to subscribers at the end of each quarter.

With the Society's standardization work proceeding at its present high rate both within the U.S. and internationally, the problem of keeping up with changes becomes a difficult one, even though the full story on all standards activity of the Society is reported regularly in the *Journal* by Hank Kogel, SMPTE Staff Engineer. This new service will assure you that your own personal or department file contains all standards and that the latest revisions have not been overlooked somewhere along the way.

If you wish to receive this service for a year, starting January 1, 1956, send your check for $7.50 to Headquarters along with your full name, company, and exact address including postal zone. Accuracy is important because an Addressograph stencil will be used for automatic accounting and mailing, and it must direct the standards to the person delegated to insert them in your binder.

If you do not already have a satisfactory file of standards on motion pictures and TV (there are over 80 in the complete set), make your check out for $27.50 and you will receive a sturdy loose-leaf binder containing all in effect on December 31, 1955, as well as the service through this year.

Check the status of your present file by comparing it with the complete index on p. 722 of the *Journal* for December 1955.—*B.N.*

Erratum

In the introduction to PH22.106, Projector Aperture for 35mm CinemaScope Prints With Optical Sound, published in the January 1956 *Journal*, p. 45, "Motion Picture Research Council Practice No. 3" should read "Motion Picture Research Council Practice No. 13."

news and reports

79th Convention Program — Exhibits

Since the Program Committee under the guidance of Chairman Ben Plakun, and the arrangements people who report to your Local Arrangements Chairman George Gordon and to Convention Vice-President Byron Roudabush have done such a thorough and early job of outlining the format of our 79th Convention you can now safely begin making plans to be on hand for the sessions that most interest you or your company. The Convention gets under way officially with the first session which is scheduled to start at 9:30 Monday morning, April 30. This is unusual but necessary because there are sixteen full-length sessions to be accommodated along with the luncheon, banquet and a rash of engineering and administrative committee meetings.

Laboratory people take notice: The Monday morning session and the afternoon session that follows the Luncheon are both on the subject of Film Lab Practices. Monday in New York is a light lab day so here is your chance to attend the convention, and also to send your key technical people, for a two-session brush-up course on the latest in the way of tools and techniques in your own specialized field of interest. And the equipment exhibits, sure to include a generous array of printers, processing machines and control apparatus, will remain open for one hour's inspection after the afternoon session adjourns.

Here are the days, sessions and special events as scheduled at press time. Ladies affairs are now being set down and will be spelled out in full glory as soon as they are firm.

Sunday — April 29
Board of Governors Meeting
Registration

Monday — April 30
Laboratory Practice I
Luncheon
Laboratory Practice II
and
TV Studio Lighting I
TV Studio Tour I

Tuesday — May 1
Oklahoma — Todd-AO
TV Film Commercials
TV Studio Tour II

Wednesday — May 2
TV Studio Lighting II
Motion-Picture Equipment
and
TV Studio Lighting III
Underwater TV

Thursday — May 3
High-Speed Photography I
and
Sound Recording I
High-Speed Photography II
and
Sound Recording II
Cocktails
Banquet and Dance

Friday — May 4
TV General and Educational I
TV General and Educational II

Exhibits: Exhibits Chairman Everett Miller reports that nearly all available space has been reserved. The Exhibit area will open at 2:00 P.M. Monday, right after the Luncheon has adjourned. Tuesday through Thursday it will open at Noon and on Friday the doors will be opened at 10 A.M. to close for good at Noon.

These companies are included on the list of exhibitors—

Andre Debrie of America
Animation Equipment Corp.
Audio Instrument Co.
Auricon Div., Berndt-Bach, Inc.
Bell & Howell Co.
Camera Equipment Co.
Camera Mart, Inc.
Cinekad Engineering Co.
Fairchild Camera & Instrument Corp.
Florman & Babb
General Precision Laboratory, Inc.
Harwald Co.
Houston Fearless
Hollywood Film Co.
Kling Photo Corp.
Magnetic Sound Camera Corp.
Motion Picture Printing Equipment Co.
Neumade Products Corp.
Peerless Film Processing Corp.
Precision Film Laboratories, Inc.
Prestoseal Mfg. Corp.
Radio Corp. of America
Reeves Soundcraft Corp.
S.O.S. Cinema Supply Co.
Strong Electric Corp.
W. M. Welch Mfg. Co.
Westrex Corp.
Zoomar, Inc.

Added Attractions: It will interest non-New Yorkers to know that the month of May is accustomed to delivering the New York area the nicest weather of the year, neither too hot nor too cold. The theater season is still in full swing and by that time the excursion boats around the island that is Manhattan will be churning away on regular schedule, so come to New York, bring as much of the family as is not tied down in school and enjoy the program of special events that will have been prepared for your family's pleasure.—*B.N.*

Board of Governors Meeting

At its first meeting of the year, held Friday, January 27, the Board of Governors appointed Ethan M. Stifle, of Eastman Kodak Co., Sections Vice-President for 1956–57. Mr. Stifle will be the first man to hold this office, recently created by amendment to the Society's Constitution.

Dr. John G. Frayne, president of the Society, in announcing this appointment, stated that "with Society membership increasing by about 15% annually we believe it necessary to have someone to coordinate the many activities of our local sections."

The Society now has seven section groups and two student chapters, and indications are that there is a need and desire for more. "It will be the job of the new Sections Vice-President to interpret Society policies for the sections, assist existing sections with programs and operations, and help to organize new ones," Dr. Frayne noted.

A training program to improve the quality of projectionist performance in theaters throughout the United States was discussed. The Board considered the need for training courses in the operation and maintenance of modern booth and stage equipment for sound and projection, and in the principles behind today's wide-screen and multi-channel sound systems.

A committee was appointed to study this problem and to discuss methods of solving it with leaders in the projection craft. Possible ways of offering the necessary training to projectionists include instructional films using the latest in training methods, printed manuals, and study session material consisting of lecture notes accompanied by color slides or slide films to illustrate the principal conclusions of the course.

This group will report its recommendations to the Board at its next meeting on April 29 in New York City. If the Board approves these recommendations, the committee will be authorized to present a detailed plan to the Board in July.

This is the fourth step in the Society's program of education for engineering students and engineers already employed in motion pictures and television. Three courses on optics and laboratory practices were initiated at UCLA in the fall of 1955; and a new course in sound recording, also sponsored by the Society, will begin at USC on February 9. In addition a committee has been formed to prepare a report on College Motion-Picture and Television Curricula. —*S.G.*

Membership Certificates (Active and Associate members only). Attractive hand-engrossed certificates, suitable for framing for display in offices or homes, may be obtained by writing to Society headquarters, at 55 West 42d St., New York 36. Price: $2.50.

section reports

The **Atlantic Coast Section** met on January 10 at Fine Sound Studios, New York, with an attendance of approximately 250. John G. Stott, Eastman Kodak Co., presented a paper on "Automatic Timing of Color Negatives" which he had prepared in collaboration with William R. Weller and J. Edward Jackson, also of Eastman Kodak Co.

The paper described a method of automatic timing of motion-picture color negatives for the making of first trial color prints. The method was derived from a color timing method in use for printing amateur roll film Kodacolor negatives. The theoretical basis and statistical analysis of results were described as applicable to one New York motion-picture laboratory. The paper was concluded with the screening of 35mm color prints illustrating the results.—*Victor M. Salter*, Secretary-Treasurer, 168 Kemp Ave., Fair Haven, N.J.

The **Central Section's** January meeting was held on the 16th at the Western Society of Engineers, Chicago. Ralph Evans, manager of Eastman Kodak Co.'s Color Technology Division, spoke to an audience of 200 on "Color and Brightness in Projected Motion Pictures."—*Howard Brauer*, Secretary-Treasurer, 7326 N. Ridge Ave., Chicago 45.

The **Pacific Coast Section's** January meeting was held in two sessions at M-G-M Studios, Culver City, Calif., on January 17. About 450 attended the two sessions, which were open to members only.

A paper by Dr. C. J. Staud, Director of Research at Eastman Kodak Co., on "Science and Technology in Color Motion-Picture Photography," which was originally given at the Lake Placid Convention, was presented by Dr. Norwood L. Simmons, Eastman Kodak Co. The paper reviewed some of the fundamental problems confronting those who work with color motion-picture film.

Douglas Shearer, Director of Technical Research at M-G-M, gave a talk on the M-G-M Panavision system, illustrated by a number of scenes from current color productions. The system uses a 65mm original negative and is suitable for making high-quality exhibition prints in several sizes and aspect ratios for high-definition, large-screen presentations. It can use multichannel photographic as well as magnetic soundtracks. A demonstration included screening of 35mm and 65mm prints derived from the same original negative.—*John W. Du Vall*, Secretary-Treasurer, 4829 Cartwright Ave., North Hollywood.

The **Western New York Subsection** held a meeting on January 24 in the Color Room at Eastman House, Rochester, N.Y. Neal Keehn, of the Calvin Co., spoke on "What's Going on in 16mm Production" to an audience of 94, of whom 33 were members. This was a highly successful meeting and considerable interest in the Society was shown by many of the guests attending.—*G. T. Negus*, Secretary-Treasurer, c/o Eastman Kodak Co., Kodak Park Works, Bldg. 65, Color Technology Div., Rochester 4, N.Y.

Obituary

Henri Chrétien, designer of the anamorphic lens that is the basis for the CinemaScope system, died February 7 in Washington, D.C. He was 77 years old.

In 1927, when he was professor at the Sorbonne and at the Institut d'Optique in Paris, M. Chrétien first showed, in a communication presented to the Academy of Sciences by Louis Lumière, the possible uses of the principle of anamorphosis in relation to cinematography. In optics, the principle of compressing and expanding images was nothing new, and even after his application of it had achieved worldwide celebrity M. Chrétien refused to be impressed by the importance of his own invention, noting in one interview that it was simply based on "known principles of optics."

Further development led to the design of a practical lens, the Hypergonar, which was introduced to the commercial market by the Société Technique d'Optique et de Photographie of Paris, of which M. Chrétien became technical director. The Hypergonar was demonstrated to the Optical Society of America in 1928. A description of it by Henry Dain may be found in the December 1932 issue of the *Journal*.

At the Paris International Exposition of 1937 the Hypergonar lens was given a public demonstration at the Palace of Light, where two interlocked projectors were used to show motion pictures on a screen measuring 60 meters long by 10 meters high, constructed on the facade of the building. The facade, and therefore the screen also, was slightly concave in order to avoid marginal distortion.

M. Chrétien's interest in optics was not confined to its motion-picture applications. In 1932 he designed the telescope at the U.S. Naval Observatory, Washington, D.C., and his only visit to Hollywood prior to the use of his lens for the CinemaScope system was in connection with the Mount Wilson Observatory.

In 1952 Spyros Skouras and Earl I. Sponable of 20th Century-Fox visited M. Chrétien in France and acquired his lens for CinemaScope. He was present at the premiere of *The Robe*, the first CinemaScope picture, in 1953; and in the following year received an Oscar from the industry. For the past year and a half he had been living in this country.—D.C.

New 16mm Magnetic Signal-Level Test Film

A 400-cycle magnetic signal-level test film providing essentially an absolute reference for the level of magnetically recorded signal is now available to the 16mm equipment and sound-recording industry. This film, long in coming, is the result of several years of discussion and study which repeatedly emphasized the need for a level reference that could be used as a basis for determining amplification, for frequency-response calibration and for overall system evaluation of 16mm magnetic recorders and reproducers. The much-needed answer failed to materialize until a Navy research project directed by Frank H. Comerci produced a technique for measuring actual values of surface induction. A paper "Absolute Measurement of Signal Strength on Magnetic Recordings" by Robert Schwartz, Sheldon I. Wilpon and Frank A. Comerci in the January 1955 *Journal* describes the theory and laboratory method used in arriving at the original induction-level measurement.

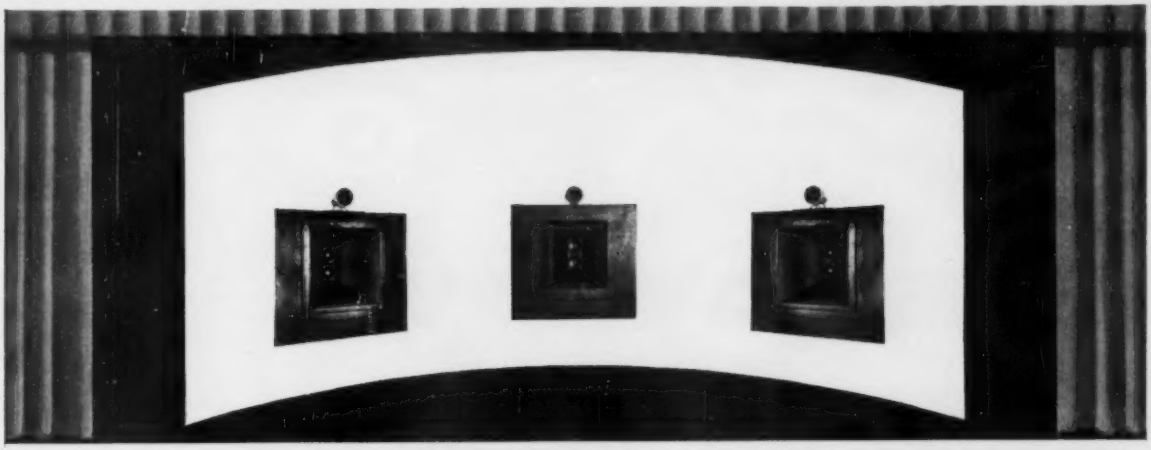
The film announced here for the first time is an original recording made on equipment of known good performance and calibrated against one of two "primary standard" samples produced by Mr. Comerci and his associates. It adheres to specifications defined by the Society's Magnetic Recording Subcommittee under the Chairmanship of E. W. D'Arcy. Tangible substance is thus given to frequency-response standardization, because this film makes possible the measurement of effective amplification of 16mm magnetic sound equipment taking into account the characteristics of the reproduce head as well as the amplifier and speaker.

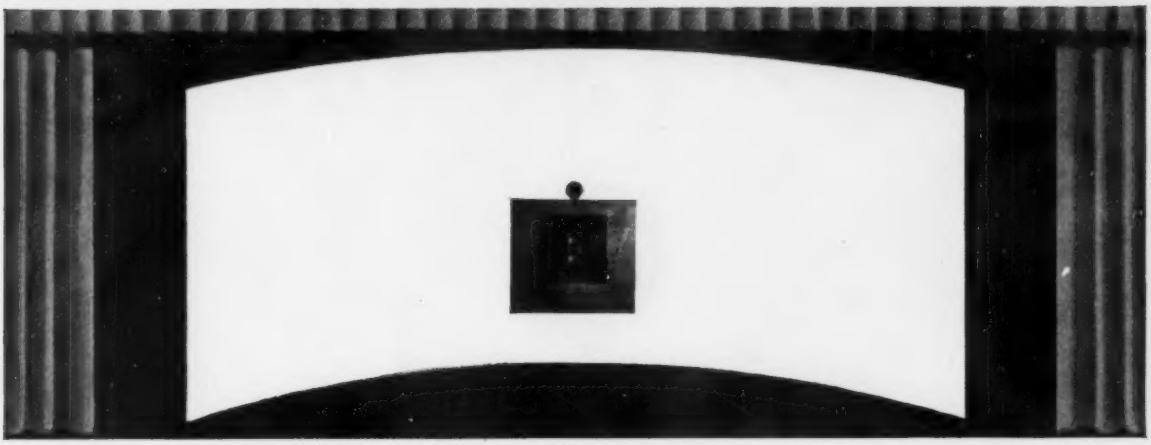
The track is 200 mils wide, recorded on the nonperforated edge of full-width coated film in accordance with Proposed American Standard PH22.97, which appeared on p. 263 of the May 1955 *Journal*. The surface induction of the recorded signal is approximately 5 db below the maximum level obtainable at saturation of the type of magnetic-coated film used. Nominal value of surface induction is 10.5 gauss rms; average variation of the surface induction over the length of the film is ±0.5.

The film is available from the Society, 55 West 42 St., New York 36, in lengths of 100 ft, not including New York City Sales Tax, at $20.00.—*B.N.*

STEREOPHONIC SOUND* IS BETTER

THAN ANY SINGLE CHANNEL SOUND





Give your customers the best

Get the full dramatic brilliance of sound of today's top-rated motion pictures!

The new Westrex Stereophonic equipment reproduces the full range, tone and quality recorded on the film. This new equipment is simpler in design and cheaper to install and maintain. Prices are 5% to 30% lower than comparable 1955 equipment.

FOR THE BEST in multi- or single channel, magnetic or photographic sound systems ...buy

- THE WESTREX
- WESTREX Standard
- WESTREX Economy

*Three channel, four channel, or six channel

Westrex

Westrex Corporation

111 Eighth Avenue, New York 11, N. Y.

Hollywood Division: 6601 Romaine Street, Hollywood 38, Calif.

Education, Industry News

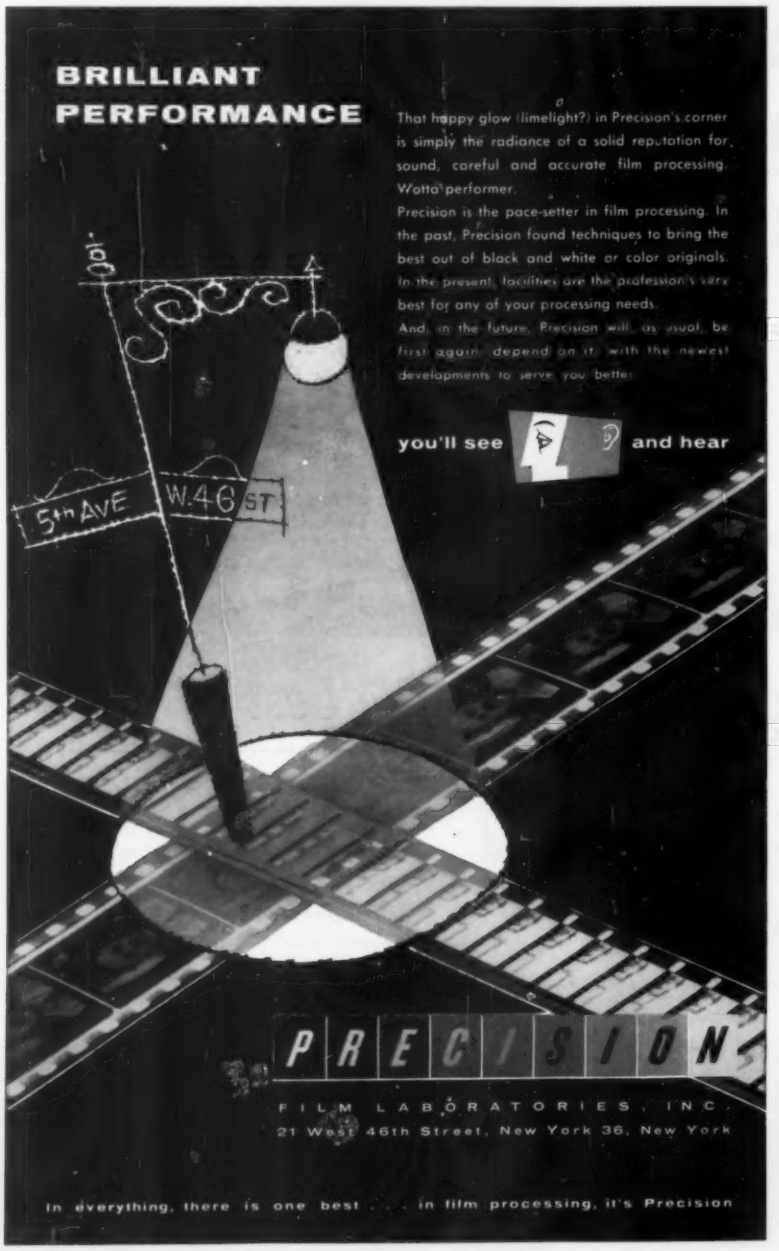
John A. Maurer recently resigned his positions as President of J. A. Maurer, Inc., and Precision Film Laboratories, Inc., to devote full time to independent research and development work, particularly in the field of 16mm motion pictures.

Harry W. Lange has been named executive vice-president and general manager of the Chicago studio operations of Kling Film Enterprises, Chicago. A veteran in production and quality control in filmmaking, Mr. Lange was 23 years with Sarra, Inc., Chicago, where he was general manager of the Chicago studio since 1952. He has produced motion pictures and slidefilms in all 48 of the United States. Mr. Lange's appointment fits into the recent streamlining of Kling's extensive operations which include three Chicago sound stages as well as the former Charlie Chaplin lot, comprising 26 buildings, in Hollywood.

Kling's Chicago studios now has as key staff: Jack Fenimore, executive producer; Hillard Rose, creative department; Manny Paull, art director; Lawrence Stein, comptroller; Dick Hertel, supervising editor; and Joe Bishop, studio floor manager.

Mr. Lange's Chicago experience began in 1924 when he joined the photographic studios of Fulton and Lawson. Subsequently, he was with Vocapix, one of the pioneer firms in business film production.

Recently, he has served as a director of SMPTE's Central Section. He is also active as a member of the American Society of Safety Engineers.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Harold C. Harsh has been named to the newly created position of Manager of Operations at Ansco. He was formerly Production Manager. In his new position, Mr. Harsh will be responsible for directing and coordinating the activities of Ansco's Camera Plant, Paper Plant, Film Plant, Warehousing and Industrial Engineering Departments.

Mr. Harsh studied at the College of Wooster, Wooster, Ohio, and at Ohio State University where he received an A.B. degree in 1931. He received a Master of Science degree in Physical Chemistry from the Massachusetts Institute of Technology in 1934 and thereupon became a production supervisor in Ansco's Paper Plant. From 1946 to 1949 he was manager of the Chemical Development Dept.

After World War II Mr. Harsh was sent to Germany at the request of the Department of Commerce to investigate progress in color photography there. He is a Fellow of this Society and a member of numerous scientific groups.

Gordon P. Mann has assumed the duties of Manager of Ansco's technical and laboratory services, according to an announcement by Robert M. Dunn, Assistant General Sales Manager of Ansco, photographic manufacturing division of General Aniline & Film Corp.

Mr. Mann, a graduate of Alfred University, joined the Ansco organization in 1937 and has held numerous executive positions. He was instrumental in formulating the Ansco Color Finisher Program, the foundation of the present huge independent color film and color print processing industry. He will now be responsible for the operation of all of Ansco's color processing laboratories, will work with a growing number of locally operated color processing laboratories in the United States and Canada, and will supervise operation of Ansco's Customer Service Dept.

The Motion Picture Industry Credit Group was chartered in April 1953 with 18 members. Today it numbers 34 of the leading motion-picture processors, equippers, suppliers and service and financial organizations in the metropolitan New York, Washington, D.C., and Chicago areas. Membership is open to any organization providing services, equipment, facilities or supplies to motion-picture and television film producers and distributors, networks and stations, sponsors, agencies and film libraries. Membership is subject to approval of the Group's Executive Committee. The Group holds regular monthly meetings at the Park Sheraton Hotel, New York, at which talks on subjects of interest to the members are given and general discussion and exchange of information take place. A Group program and further information may be obtained through Group Secretary W. W. McAdam, National Association of Credit Men, 229 Fourth Ave., New York 3.

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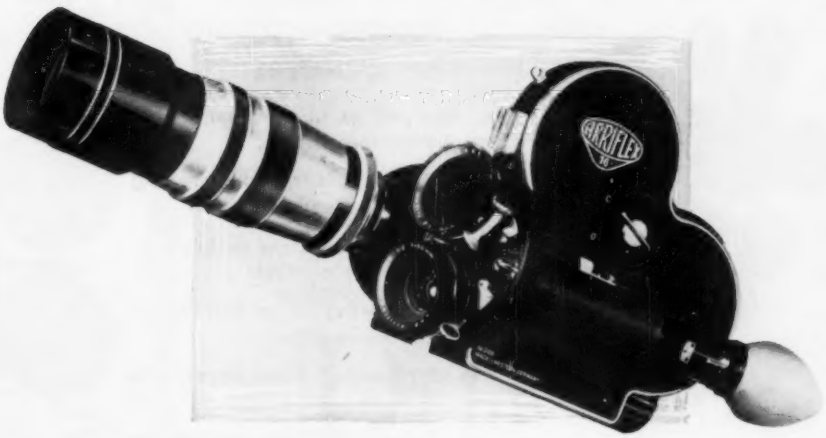

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Sound Course

The opening session of the new course for sound technicians sponsored by the Society through the Education Committee's Subcommittee on Sound Recording was held on February 9 at the University of Southern California. In the photograph above, taken at the session, are, left to right, Lorin Grignon, Chairman of the Subcommittee; Herbert Farmer of U.S.C.'s School of Cinema; Tom Carman, Business Agent, Sound Technicians Local 695; and Dr. John G. Frayne, SMPTE President.

Herb Farmer reports that over 80 students registered for the one-semester course in "Elements of Sound Recording." The instructor is Caril Shipman, who is in charge of all sound systems employed at Disneyland. The class is meeting Thursday evenings, February 9 through June 7 at the Cinema Building, 659 W. 35th St., Los Angeles, from 7:30 to 10:10 P.M. Registration fee is $60.

In the January *Journal*, which carried an announcement about the Sound Course on p. 62, the name of Ellis King, Associate Professor of Engineering at UCLA, was unfortunately omitted from the listing of the members of the Sound Recording Subcommittee. Dr. King has been very active in the formative work of the Subcommittee and was host to the group for its January meeting, which was held on the UCLA campus. After dinner, at which members of the Subcommittee were guests, he showed the group through the engineering laboratories at UCLA.

Other members of the Subcommittee, in addition to Lorin Grignon, the Chairman, are Herb Farmer, Tom Carman, Barney Freericks of Twentieth Century-Fox, Lloyd T. Goldsmith of Warner Bros., Fred R. Wilson of Samuel Goldwyn Studio, and William Stafford of M-G-M.—*D.C.*

Capital Film Laboratories, Inc., of Washington, D.C., announced the appointment in January of **Garland C. Misener** as Director of Laboratory Operations.

Mr. Misener comes to Capital from the Ansco Division of General Aniline & Film Co., Binghamton, N.Y., where he served from 1949 until the present as Manager of Professional Motion Picture Services. In his new capacity at Capital, Mr. Misener will supervise all laboratory operations for the company and oversee the planning and execution of an extensive expansion program of laboratory operations in the near future.

Prior to his latest position with Ansco in Binghamton, Mr. Misener was for four

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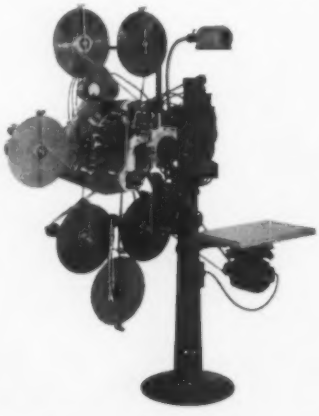

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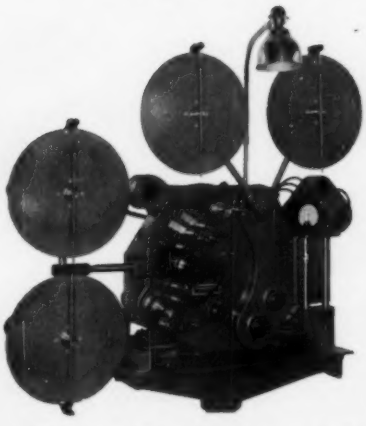

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years on Ansco's Hollywood staff. While in Hollywood, he assisted in the introduction of Ansco Color and won an Academy of Motion Picture Arts and Sciences Award for his contribution to the design of the color print scene-tester, now widely used in the motion-picture industry.

In his earlier experience, Mr. Misener served as Sound Engineer with Warner Brothers, and for five years was a physicist with the Eastman Kodak Research Laboratories. During World War II, he was in charge of sound recording at the Signal Corps Photographic Center, attaining the rank of Major.

Mr. Misener, a native of Lapeer, Mich., is a graduate of the University of Michigan in Engineering Physics, and has pursued an extensive program of graduate study, both at Michigan and at the University o Rochester Institute of Optics in the fields of optics and television engineering. He is a Fellow and Governor of this Society and a member of the Optical Society of America, the Photographic Society of America, the Academy of Television Arts and Sciences, the American Society of Cinematographers, the Armed Forces Communications Association, and Tau Beta Pi, honorary engineering society.

A National organization of industrial photographers, believed to be the first of its kind in the world, has been formed under the sponsorship of the Photographers' Association of America. Richard C. Kinstler, who heads the photographic division of Procter & Gamble Co., Cincinnati, Ohio, is chairman of the steering committee. Other committee members include: Roy Wolford, of Northrup Aircraft, Hawthorne, Calif.; Norman Germond, Chrysler Corp., Detroit; Peter Carey, Bendix Corp., Teaneck, N.J.; Morris Gordon, Western Electric Co., New York; and Ed Purrington, Ford Motor Co., Detroit.

The committee has formulated a specific program concentrating on nine major points. These include aiding the industrial photographer to do a better job for management through sharing the skills and techniques of hundreds of photographers throughout the country, the holding of periodic regional photo short courses; operating lecture and placement bureaus; conducting an annual photo exhibit and the annual National Industrial Photographic Conference in conjunction with the yearly PA of A convention; and providing illustrated taped lectures for groups in isolated areas.

Current effort of the group is planning the national Industrial Photographic Conference to be presented this year at the Conrad Hilton Hotel in Chicago, July 22–27. The nation's top men in the industrial photographic field will deliver talks and demonstrations on the latest techniques and current problems. The steering group also is collecting articles and materials of current interest to industrial photographers.

A membership drive aimed at professional photographers working in industry is underway. A brochure describing in detail benefits to be derived from membership in the new organization will be available shortly and will be distributed by the PA of A. These may be requested by individuals, groups or industries.

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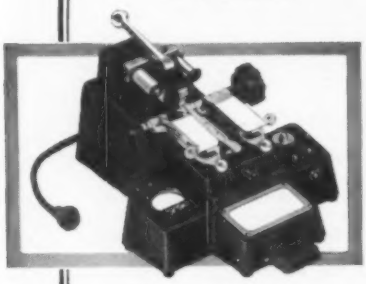

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Patience and Latitude

While workers in profusion continue to cultivate aspect ratios — variously — and while others may serve more strenuously in the cult of standardization, the historical review reprinted below may show essentially where we have been and where we continue going.

Mr. Limbacher, author of this article reprinted from *Films in Review* of October 1955, is Audio-Visual Director of the Dearborn, Mich., Public Libraries where he handles all motion pictures and television. He writes articles like this one out of a love for the movies. We understand that his thesis for a Masters in Education at Indiana University was on the history of color film from hand-painted films to those in Color by DeLuxe. He is now working on a book manuscript, "Four Aspects of Film," from which the following has been abstracted.

Mr. Limbacher has noted that in the past ten years this *Journal* has been a considerable help to him. Readers who wish to augment the outline he has written will find their letters welcomed by the Editor.—*V.A.*

Widescreen Chronology

Widescreen Experimentation Is Almost as Old as the Movies Themselves

By JAMES L. LIMBACHER

IF THERE were to be a birthday party celebrating the advent of widescreen motion pictures, how many candles would be atop the cake? Two? Ten?

No, fifty-nine.

Like any new invention, motion-picture film was not at first standardized. William Friese-Greene's first movies were huge strips of celluloid; Pathé's film was 28 mm wide; the width of Biograph and Mutoscope's was 2.75 inches; and the Lumiere brothers' film had only one sprocket hole per frame. Thomas A. Edison made his movies on 35mm, with four perforations per frame near each edge of the film.

Chiefly because Edison sold more motion-picture equipment than anyone else, his film size and his screen size — four by three — became the worldwide standard. Also, we must remember that the early motion pictures were exhibited not in theaters but in stores, which were long and narrow. If movies had first been shown in theaters, the natural tendency would have been to make the image as wide as the theater stage.

The first widescreen process dates back to 1896 when Raoul Grimoin-Sanson presented Cineorama, which consisted of ten projectors throwing ten images on a huge circular screen. Cineorama was later shown at the Paris Exposition, along with a widescreen presentation by the Lumiere brothers on a screen 48 feet high and 53 feet wide.

Americans first saw widescreen movies in the travelogs of Lyman H. Howe, who shot his films with a short focal-length lens. The resulting pictures tended to envelop the audience and to induce an illusion of the audience being part of the action.

Professor J. Louis Peck of France demonstrated a huge curved screen at the New York Rivoli in 1920 with scenes from Paramount's *Everywoman*. The critics were excited about the good focus and "the absence of eyestrain."

In 1921 George W. Bingham exhibited a wide-angle projection system he called Widescope, consisting of two films projected side by side and giving a double-width image.

In the middle '20s the Germans introduced a 42mm film called Tri-Ergon, which had a premiere at the New York Cameo.

Lorenzo del Riccio launched his Magnascope process in 1925 and it had more longevity than any previous process. A special lens gradually "blew up" the film image to four times its regular size. The effect was spectacular and usually was reserved for the climax of the picture. The Magnascope lens was first used for the battle scenes in *The Big Parade*, and later in the climaxes of *Old Ironsides*, *North of '36*, *The Thundering Herd*, *Chang*, *Twinkletoes*, *The Iron Horse* and *Wings*. It experienced a 1948 revival in Selznick's *Portrait of Jenny*, and again in 1952 in his *The Wild Heart* (at the New York Paramount).

Natural Vision, promoted by the late George K. Spoor and P. John Berggren, used 70mm film and was projected on two screens so arranged one behind the other as to give a stereoscopic, widescreen effect. *The American*, starring Bessie Love and Charles Ray, was shown in Natural Vision. In 1929, sans stereoscopic effect, it reappeared as Fox's Grandeur process.

But for the arrival of sound, Grandeur might have become the new standard width for movies. However, theater owners were spending too much money wiring their theaters for sound, and could not afford to buy projectors that could handle 70mm film. After three Grandeur films, *Fox Movietone Follies of 1929*, *Happy Days* and *The Big Trail*, Grandeur disappeared. Twentieth Century-Fox repeatedly announced they would revive it in "roadshow" presentations.

Several other wide-film processes appeared simultaneously with the arrival of sound: Paramount's Magni-film (56mm film) was used for *You're in the Army Now* in 1929; MGM's Realife (65mm) for King Vidor's *Billy the Kid* in 1930; and Warner Brothers' 65mm-film for *Kismet* in 1930 and *The Lash* in 1931.

In France, Claude Autant-Lara and Abel Gance had introduced the "triptych screen" — three regular-sized screens, on the outer two of which were shown scenes supplementing the image in the middle. Autant-Lara used the process for *Pour Construire un Feu* (1925), and Gance for his monumental *Napoleon* (1927).

A more radical departure was the process developed in 1928 by George Hill and an Italian, Professor Alberini, recently reported in *Films in Review* (October 1954). Its basic difference was that the film was shot and projected horizontally. Although impractical then, the idea reappeared 25 years later as Glamorama, and even more recently as VistaVision.

After all these systems had run their course, Adolph Zukor of Paramount, speaking for the Producers Association of America, assured exhibitors they would be burdened with no more wide films. By mutual consent, the producers had called a halt.

But experimentation continued. At the

World's Fair in New York in 1939 the late Fred Waller presented Vitarama, which used 11 projectors strapped together to project an image on a curved screen surmounted by a quarter dome. Although Vitarama excited those who saw it, it was impractical for theatrical use. Or was it? Vitarama, without the dome, and with refinements, and only three projectors, emerged in 1952 as Cinerama!

The success of Cinerama, the reintroduction of 3-D, and the competition of tiny-screen TV, made widescreen images on one film the great desideratum. The answer was "anamorphosis," the principle of which was patented as early as 1862 and demonstrated as early as 1898. When Dr. Sidney Newcomer projected his "squeezed" films in 1930 the film industry was not interested. When Professor Henri Chrétien demonstrated a similar system a year later, Paramount optioned but did nothing with it. In 1937 Chrétien exhibited his anamorphic system at the Paris Exposition, but it was not until 1952 that Spyros Skouras of Twentieth Century-Fox took it up and renamed it CinemaScope.

CinemaScope's success is history, but it has not been, and is not, without its challengers. Other anamorphic systems include Warner-SuperScope, developed by Zeiss-Opton in Germany for Warners; Vistarama, developed by the Simpson Optical Company for Carl Dudley; Cinepanoramic, developed in France; CameraScope, the English version of Cinepanoramic; SuperScope, invented by the Tushinsky Brothers for RKO; Vidoscope, developed and sold by Walter Futter; and Delrama in England. All are compatible with CinemaScope and, with the exception of SuperScope, which has a 2:1 aspect ratio, are the same basic process as CinemaScope.

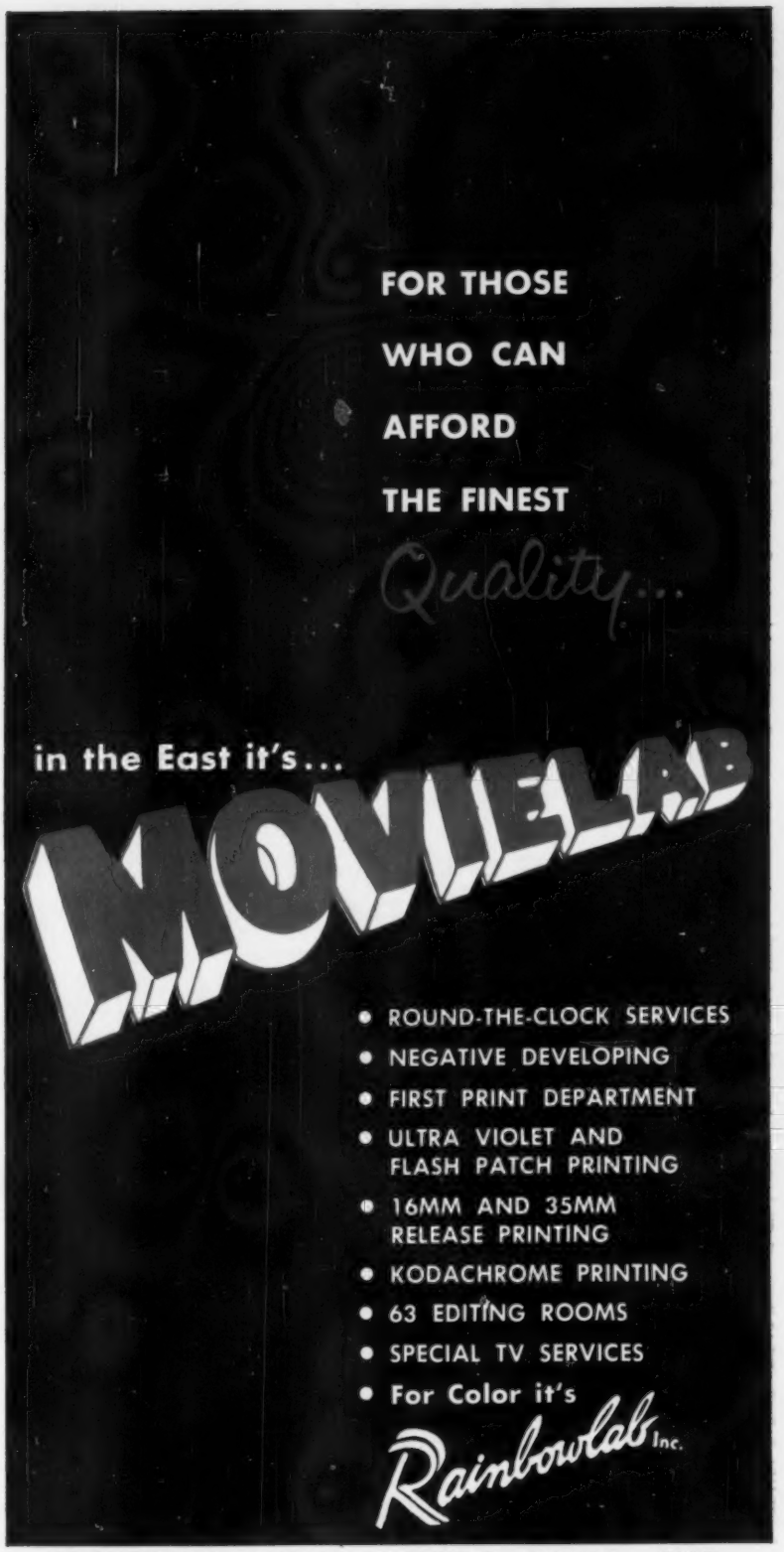
The Todd-AO process, using 65mm (or is it to be 70mm) film, will enter the widescreen race this year with a roadshowing of *Oklahoma*. VistaVision, using images photographed horizontally on double frames reduced optically to 35mm images, or, in large theaters, projected horizontally, was introduced late in 1954 in *White Christmas* by Paramount, which has completely converted to horizontal double-frame photography.

Other large film processes include MGM's Panavision (65mm), Twentieth Century-Fox's 56mm film, and Camerama. Other widescreen systems which should be mentioned for the record are Superama, Sonoptic, Plastorama, Polyvision, AMP-O-Vision, Photorama, Perfect Tone, Scenic Scope, Paravision and Metrovision.

National Theatres' Cine-Miracle process is similar to that of Cinerama in that it uses three films and three projectors. But the equipment is much more mobile and the merging lines are not in evidence.

Walt Disney's Circarama completes the cycle of widescreen processes. It consists of 11 images projected on a circular screen, and this, basically, is the Cineorama process of 1896.

It is possible but not likely that widescreen standardization will come in 1956. The contenders most likely to be victorious are CinemaScope and VistaVision. But wait — someone has just announced a 42mm film which has an aspect ratio of 3:1 — which is larger than even Cinerama's projection ratio. I wonder. . . .



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A Sagacious Solution to the Standardization Situation

By JAMES P. CUNNINGHAM
Equipment Editor, *The Film Daily*

The wide-screen and multichannel sound techniques of recent origin are the product of a considerable investment in developmental research, and have in turn presented such a clear case for further investment in technical improvement that a second round of developmental research programs was immediately undertaken.

The extending of aspect ratios had demonstrated that in their then present state, lenses, film, screens, film processing methods, studio techniques of photography and sound recording and cameras and projectors were unable to meet the quality demands of discriminating moviegoers. It is assuring to recognize that engineering has successfully met this second challenge. Today every film producer has available any of several high-quality systems for photographing his picture. Also, he can take his choice of release-print types with assurance that full value will be realized in theater projection. Only one serious problem remains, and that is the complication presented by the multiple release-print standards in current use. Not all of these standards can be accommodated in every theater booth; yet the designers are to be complimented on the fact that there is none of the new systems that cannot be accommodated in any theater booth.

If we consider the initial phase as one of innovation, and the second as one of consolidation in which many and varied efforts were brought to fruition almost concurrently, we are then prepared to consider the phase which must next be entered as one of integration, a period in which the virtues of all present-day processes must be made available to everyone, but without stifling the type of creative engineering effort responsible for the gains of the past four years.

How then to provide a solution to this problem that will be accepted with equal satisfaction by those who recommend a return to a single standard, as well as by those who endorse the sensible philosophy of continued competitive development in several directions at once. One proposed solution which has on its side the forces of logic, if not necessarily of reason, is shown here on the opposite page. This unique solution, simple in concept, although complex in its realization, is aimed at providing a single equipment for the theater that would serve all projection purposes; in short, an all-purpose projector. There is little doubt but that such an approach could be made promptly to swing the film industry into a fourth and final, or compensation, phase of development. Compensation in the sense that the door would be opened to a real payoff for all trade interests, and final in the terminal sense.

It should be recognized at the outset that the term All-Purpose is a misnomer in its application to any mechanical contraption available for motion-picture presentation in theaters up to this date. Not that there has not been a need for such an equipment, loaded with every conceivable gimmick and gadget required to accommodate the countless methods, techniques, processes and media for advancing the art of projecting images on a theater screen.

The need for a truly all-purpose projector has been further intensified by the deep concern within the industry over the problem of standardization.

And so there appears, now, a truly all-purpose projector, a projector to out-purpose any other all-purpose projector, and at the same time to solve the problem of standardization.

The closest we have to an all-purpose projector today is the projector which merely accommodates standard 35mm and 65–70mm positives. The proposed all-purposer will take anything from 3 $\frac{6}{8}$mm to 178 $\frac{7}{7}\frac{7}{8}$mm. If that doesn't please the one-standard people as well as the multiple-standard bearers, nothing will, nothing can.

And while great minds of projector technology have long been disturbed over projection standards, some other great minds have been equally disturbed over standards for the special equipment that they manufacture for theaters. We refer to the engineers and manufacturers of pizza-pie ovens, popcorn poppers and all of those other machines which have become so closely related to the art of motion-picture presentation. To give them a break, too, the all-purpose projector was designed to embrace the technological requirements of both acetate and hot dog, to perfection—at least.

Any criticism of the structure of the all-purpose projector by those belittlers who might think they see in its lines a hint of Rube Goldberg, should take into account the compactness of the projector. Not a single pulley, ceiling wire or foot pedal was used in the design. The proposed projector operates on the principle of a flick of a switch—and there are hundreds of switches, requiring hundreds of flicks.

A rapid examination of the all-purpose design is not recommended; but if the reader insists, he probably will not notice in his haste what may appear to the more meticulous minded to be serious omissions in construction. Such omissions, however, do not exist, although the designer has seen fit to leave certain less fundamental components unmarked.

Much recognition of late has been given to the challenging aspects of this solution to an equally challenging problem. Yet thanks must also be given to those engineers whose years of serious effort dedicated to advancing the technical aspects of the motion-picture art have in some measure, we admit, served as an inspiration and a guide, without which this project could not have achieved such rapid and faultless completion.

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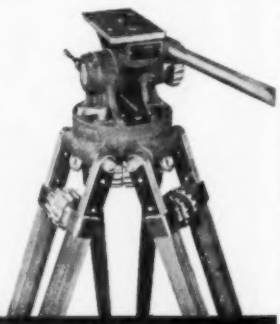

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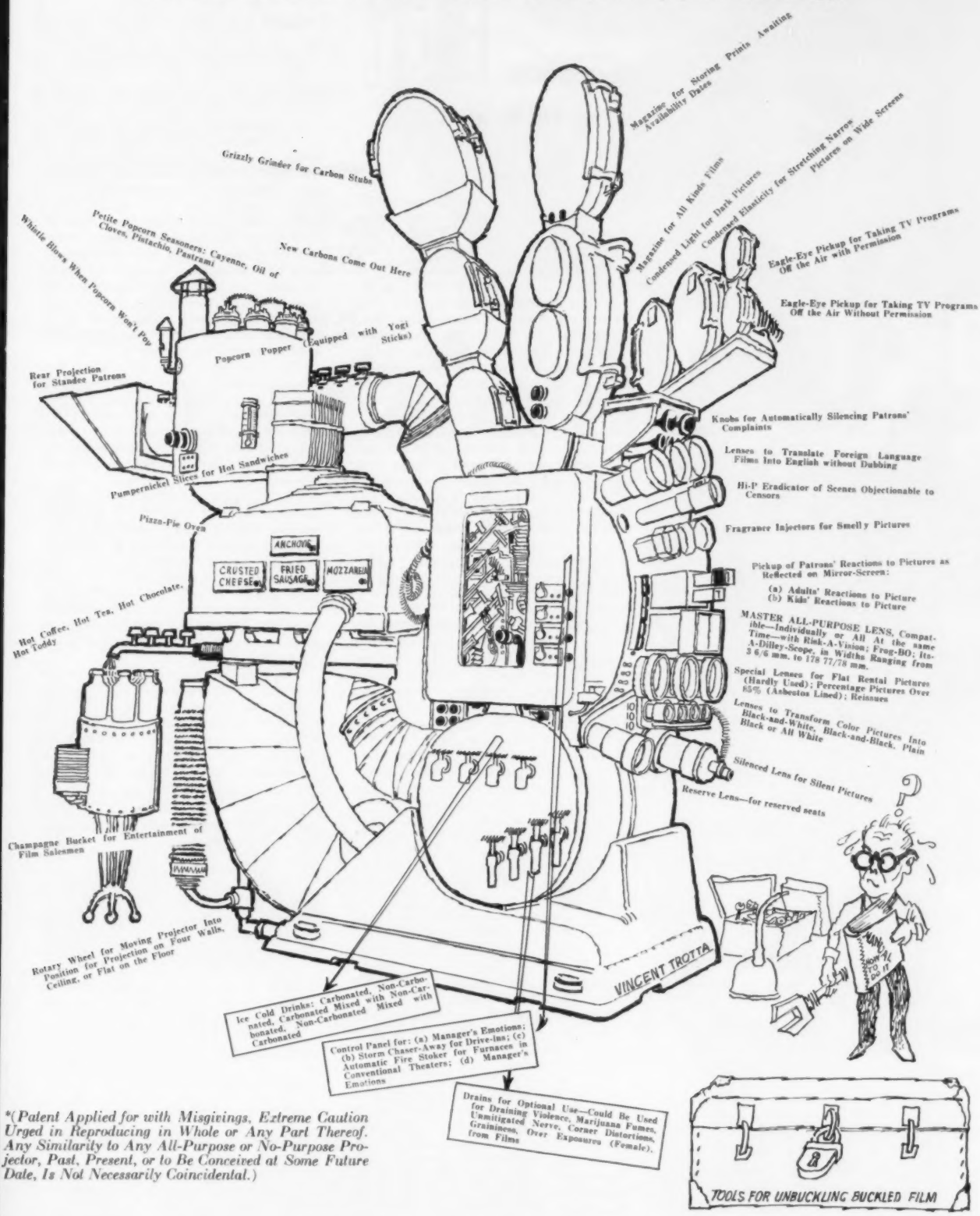
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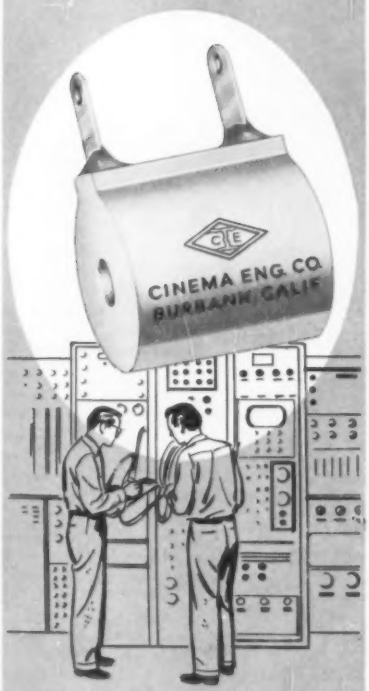

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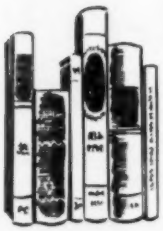

Electron'c Motion Pictures

By Albert Abramson. Published (1955) University of California Press, Berkeley 4, Calif. 212 pp. Illus. Incl. Glossary and Index. 6 × 9 in. Price $5.00.

The historian, who is the first to explore a new field, undertakes a difficult task. He begins the long time-consuming work of extracting the important events from a mass of historical data, and of giving each proper emphasis in relation to the whole. Subsequent historical writers may build upon his work, so that eventually those facts of real historical significance emerge in correct perspective free of trivial detail.

Albert Abramson, a television engineer, is the first to write a history of the development of the electronic camera. In his book, particular emphasis is placed on the future of the television camera in electronic motion-picture production. His story begins with the work of Edison in motion pictures and of Nipkow in television and carries the reader through the development of the Electronicam system and magnetic video tape.

For his history of early developments in both motion pictures and television, the author evidently is able to rely on the judgment of previous historians; but in the new fields of television recording and electronic motion-picture making, often too much reliance is placed on the sensational claim of press agents. In general, this history suffers from a lack of proper emphasis on historical detail, and a lack of criticalness in evaluating technical aspects of the newer developments, perhaps the unfortunate consequence of being the first work of its kind in this specialized field.

For example, it is stated in a discussion of the Baird mechanical scanning disk system (p. 77): "It became obvious that no mechanical method, regardless of its degree of perfection could compete with an all-electronic television system." But in discussing magnetic video tape (p. 13) the author says, "Without any of the optical losses present in television film recording and with the electrical corrections possible in a television system, the magnetic process should produce recordings equal to live television quality." But yet, magnetic tape certainly must be classified as a mechanical scanning system! How can we reconcile these two statements?

There is much evidence that Mr. Abramson spent a great deal of time and effort in research in preparing this book. An extensive bibliography covering the source material makes the book a useful starting point for the future historian. A glossary of technical terms is also provided.—*R. M. Fraser*, National Broadcasting Co., RCA Bldg., Radio City, New York 20.

Cinéma et TV en Couleurs

By Jean Vivié. Published (1954) Editions B.P.I. 79, Champs-Elysées, Paris-8. 206 pp. 151 illus., 19 color plates. Paper cover. 5¼ × 8¼ in. Price 3,400 francs.

This book is a summary of a course given annually on that subject at the École Technique Photo-Cinema (Paris).

After a historical sketch on the development of color cinematography, the first chapter is devoted to an explanation of the physical properties of light, the physiology of color vision and the classification of colors. This section is followed by a lucid description of the principles, methods and applications of the trichromatic system of color reproduction.

The main section of the book gives an excellent analysis of more than twenty commercial processes which have been used in color cinematography. It would be unwise to assert that some of these processes are only of historical interest as, for example, the obsolete processes which made use of lenticular film may yet find considerable application in color television.

The book also deals with numerous topics associated with color photography, such as studio lighting, the use of filters, color sensitometry and densitometry, and many others. In fact, the whole extensive subject of color cinematography is as thoroughly treated as can be done in a work of this size.

The only adverse comment which could be made is that the title of the book is somewhat misleading, as only one short chapter is devoted to color television. It does, however, give a good description of the various color television systems pioneered in the United States together with some interesting information on the high-definition sequential-simultaneous system which has been developed by the Societe R.B.V.–Radio Industrie.

The book is distinguished by its use of informative color diagrams and color reproductions in addition to a great many excellent monochrome figures. A short bibliography and a table of contents are included.—*Andrew Tarnowski*, Research Laboratories, Eastman Kodak Co., Rochester, N.Y.

High-Speed Photography Volume 5 is a 359-page, paper-bound reprint volume from the *Journal* for July 1952 through February 1954. It contains a 9-page bibliography and 37 articles grouped under five headings: camera equipment; accessory equipment; applications of high-speed photography; general surveys; and data pertaining to high-speed photography.

Many of these papers are from the program of the First International Symposium on High-Speed Photography held at Washington, D.C., in October 1952.

Copies are available from the Society headquarters at 55 West 42 St., New York 36, at $4.50 a copy, with discounts for members or for large lots.

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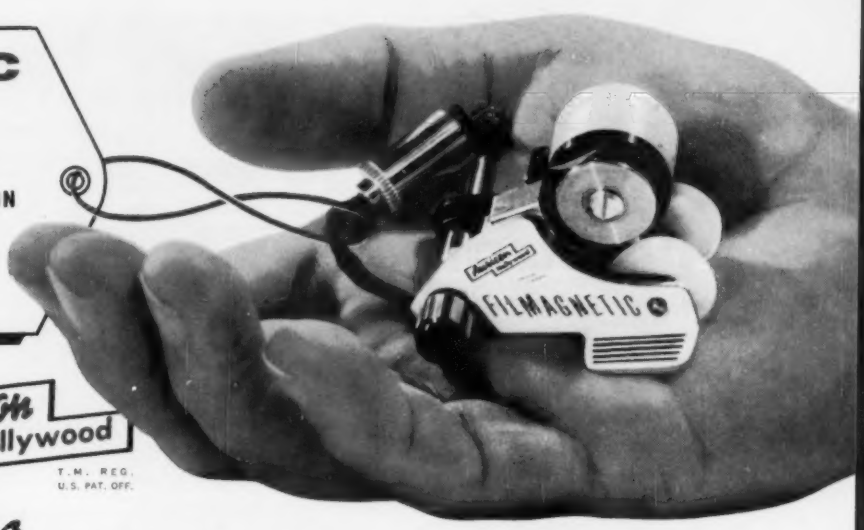

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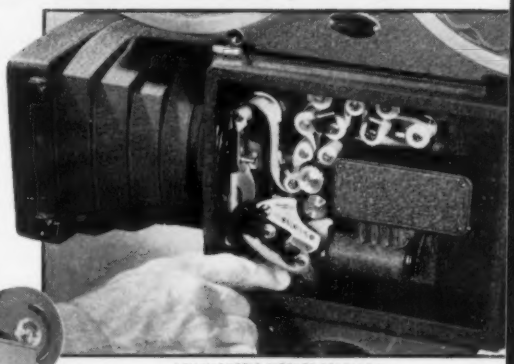

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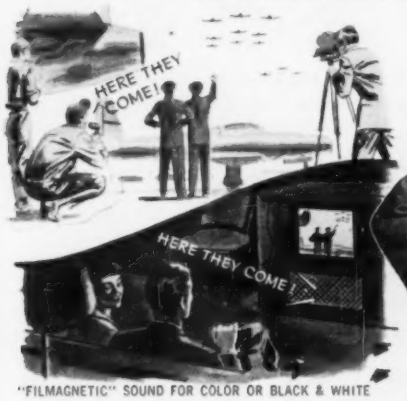

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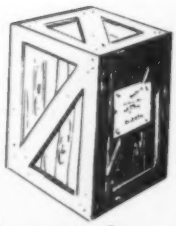

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Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

Some New Aspects of Photogrammetric Equipment

By JOHN A. EIKELMAN

(Condensed from the paper and demonstration presented on October 6, 1955, at the Society's Convention at Lake Placid N.Y. by the author from Coleman Engineering Co., 6040 W. Jefferson Blvd., Los Angeles 16.)

Acceleration of photo interpretation has been made possible by new photogrammetric equipment. Necessity for this equipment was brought about by the increased usage of large quantities of film, both still and motion-picture, as in high-speed photography and aerial photo reconnaissance. For example, many reconnaissance planes in the interest of national defense use several cameras each. Speeding up the process of interpretation while maintaining and improving accuracy has therefore been a major task of photogrammetric engineers.

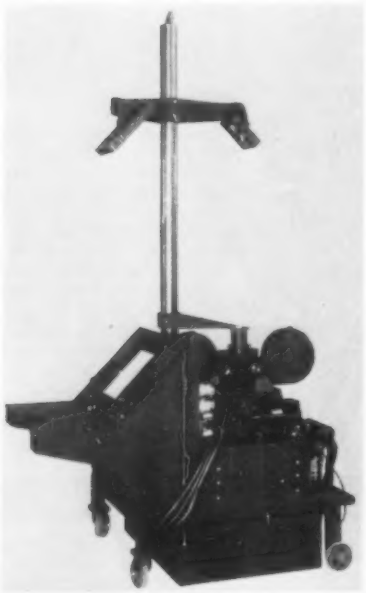

Fig. 1. Coleman Boreader is an optical and electromechanical machine designed for rapid reading and recording of image position data from 35mm film exposed in bore-sighted cameras.

Coleman Engineering Co. over the past five years has developed several pieces o semiautomatic photographic interpretation equipment to aid military personnel in the task of analyzing and interpreting engineering test photographs. The Coleman Boreader (Fig. 1) is an optical and electromechanical machine designed for rapid reading and recording of image position data from 35mm film exposed in bore-sighted cameras. (The Mitchell camera, incorporating pin registration of film, has been used widely for this purpose.) X and Y offsets of the image from an established point are measured by powered traversing of the image to the intersection of fixed crosshairs scribed on a viewing screen. With the image positioned on the crosshairs, the offsets can be automtically recorded by pressing a button which will activate a card punch, teletype tape punch, magnetic tape recorder, or an electric typewriter. As an auxiliary feature, a screen on a rotating table is provided by which image attitude measurements can be made and semiautomatically recorded. The operator aligns a reference crosshair on the screen with the apparent axis of the projected image, and by pressing a button, records the angular offset of the image from any predetermined datum angle. This device is capable of measuring at any point in the X-Y directions to an accuracy of ± 0.0004 in. This accuracy relates to a least count of 10μ. The total error in angular measurements at any point throughout the travel of the rotating table is within $\pm 1'$.

The Powered Comparator (Fig. 2) is a machine similar to the Boreader but adapted to the rapid reading and recording of comparative data from glass plates and film $5\frac{1}{2}$ in. wide. Recently, adaptation for reading of 35mm (both single- and double-frame) and 70mm film has been accomplished. Traversing controls are fully powered through joy stick manipulation up to and including final positioning of the image. The Powered Comparator has a total measuring error at any point in the X-Y directions within ± 0.0004 in.

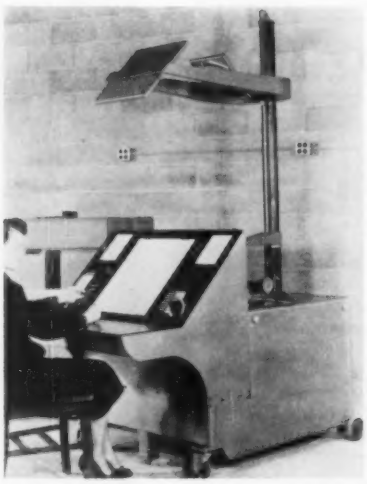

Fig. 2. Powered Comparator is similar to the Boreader but is adapted to the rapid reading and recording of comparative data from glass plates and film $5\frac{1}{2}$-in. wide.

The Coleman High Speed Comparator (Fig. 3) is an optical and electromechanical machine designed to fufill the requirements for very rapid reading and recording of image position data from $5\frac{1}{2}$-in. photographic film. The least count of this device is 50μ, which distinguishes the use of Coleman High Speed Comparator from that of the Powered Comparator. X and Y offsets of images from an arbitrary point located off the film are measured by manually traversing a ground-glass viewing screen marked with crosshairs and automatically recording the measured offsets of the image by means of auxiliary equipment such as card punch, electric typewriter or teletype tape punch. The total measuring error at any point in the X-Y direction is within approximately ± 0.002 in.

Fig. 3. High Speed Comparator is distinguished from the other machines by its least count of 50μ.

The salient feature with regard to the design and construction of all three of these machines is the adaptation and application of proved mechanical and electromechanical design techniques and components to the problem. A complete absence of vacuum tubes in this data processing equipment has been considered by some testers to be an additional salient, attractive feature. The Coleman Engineering staff considered this approach the most sound in that it would favor the achievement of rugged, reliable equipment having a high utilization factor. This has proved to be the case, for operating data over the past three years show 90–95% availability with 5–10% nonutilization due to routine maintenance.

Present and future requirements indicate the necessity for application of electronics in the design of future systems to meet the need of photogrammetric engineering. New developments, still underway, will be described in a future report.

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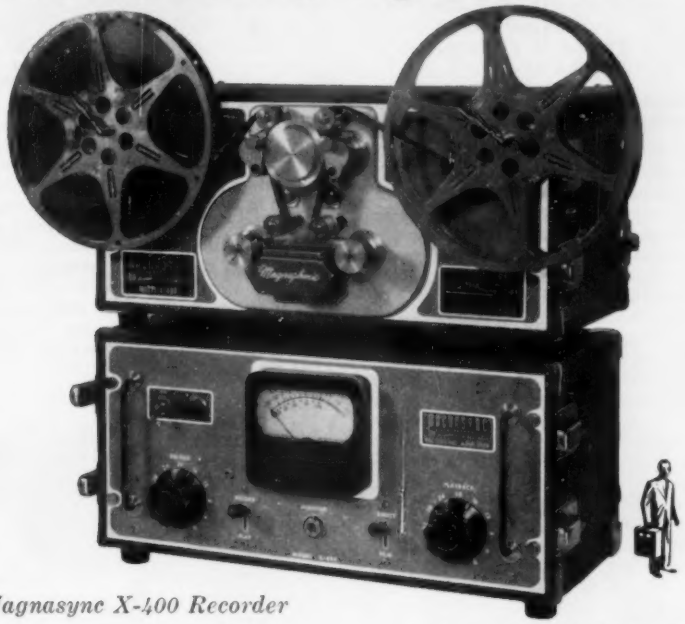

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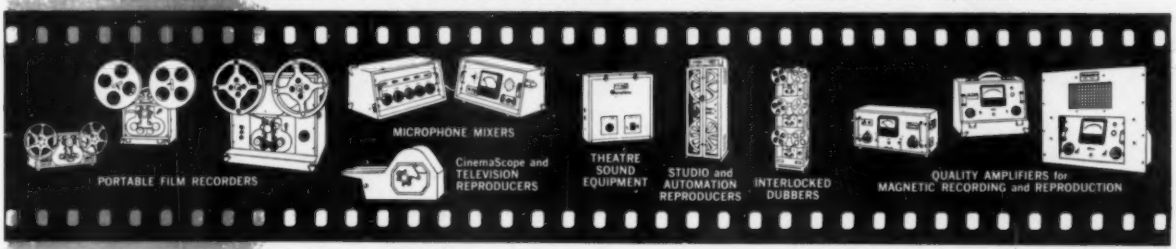

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Modifications of Military Photographic Equipment

By R. KUHAGEN and D. STERN

(*Condensed from the paper presented on October 22, 1954, at the Society's Convention at Los Angeles, by the authors from Gordon Enterprises, 5362 N. Cahuenga Blvd., North Hollywood, Calif. Two other equipments, the Gordent 15 Intervalometer and the Focalscope, were described in the August 1955 Journal.*)

A Modification of the Military Cine Phototheodolite

The military Cine Phototheodolite was originally designed to be used in pairs for triangulation purposes. They were initially used to track anti-aircraft bursts, providing an orientation in space as to the position of the burst with respect to that of the aircraft. The instrument exposes the pictures on 35mm film and records such data as the azimuth, elevation and a time identification on each exposed frame through a supplementary optical system.

The instrument's normal operating speed is 16 frames/sec. Since the resulting film is to be used for accurate data reduction and analysis in determining position in space of rockets, guided missiles and similar objects, the time interval from frame to frame must be accurate to provide a two-speed transmission for 2 and 10 frames/sec operation.

The modified instrument, Model 79GE (Fig. 1), was fitted with a synchronous, hysteresis-type of motor, which locks in with the frequency of the power supply.

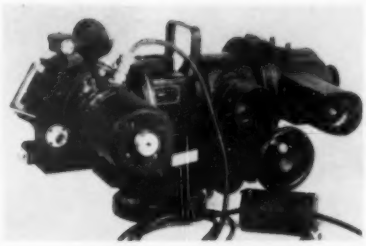

Fig. 1. Modified Military Cine Phototheodolite.

The power supply is a 60-cycle, 115-v power source with the frequency accuracy held to 1 part in 25 million. The motor is coupled with a special transmission designed to allow rapid change of frame speeds (Fig. 2). The change is accomplished by the movement of a lever, plus the rotation of the motor 10° on its shaft axis. This movement engages or disengages two sets of gears in the fashion usually associated with a straight selector-type transmission. With this redesign the time interval between frame exposures can be considered constant. The resulting film can be employed for obtaining extremely accurate pictures of aircraft, or aerial objects, in relationship to other phenomena. These Cine Theodolites, as modified, have been in use for some time and have given extremely satisfactory service on several critical programs.

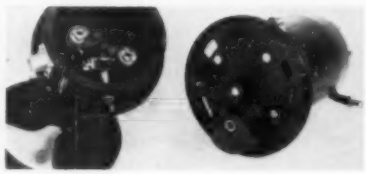

Fig. 2. Transmission of the Modified Cine Phototheodolite.

Night Shutter Missile Recording Camera System, Type GE22 and Type 30GE

These cameras consist of specially modified components designed to make possible the use of time exposures with a focal-plane shutter on a large (9 × 9 in.) format. The system includes a modified film magazine, vacuum pump system and d-c rectifier (Fig. 3).

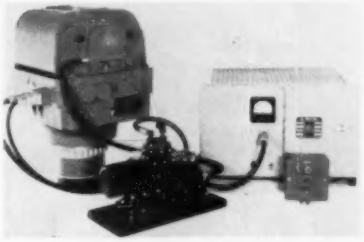

Fig. 3. Missile-Recording Night Shutter Camera System.

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mat and is manually operative for focusing through a range from 10 ft to infinity. A desirable feature is that the lens is nonrotating during focusing. Also provided are a remote-control connection with indicator light allowing the operator to pulse the camera manually or by means of an intervalometer, two pulses being required to open and close the shutter. The focal-plane shutter can be replaced with an instantaneous-type unit which incorporates the standard speed range. Shutter assembly includes a capping curtain which covers the film while the shutter curtain slit is transported across the film. The capping curtain moves out of the optical path after the shutter curtain is reset.

Weight of the complete camera is approximately 45 lb. Recycling time is approximately 2 sec. Use of a vacuum insures film being held perfectly flat at the critical plane during exposure. An interesting feature of the vacuum supply is a constant flow reservoir to prevent pulsation or intermittent loss of vacuum in the magazine.

New 8mm Copper-Coated Carbon for Motion-Picture Projection

By R. B. DULL and F. P. HOLLOWAY

(*Condensed from the paper presented on October 4, 1955, at the Society's Convention at Lake Placid, N.Y., by the authors from the National Carbon Co., Fostoria, Ohio.*)

National Carbon Co., A Division of Union Carbide and Carbon Corporation, has developed an improved Suprex 8mm carbon designed primarily for use at 70 amp. At this current it burns 10% slower and produces from 7 to 10% more light than the old carbon, depending upon whether the projection lamp is set for 80% side-to-center light distribution or for maximum screen light. The new carbon is noticeably steadier than the old, and the light level on the screen is more reproducible. At 70 amp and 80% side-to-center light

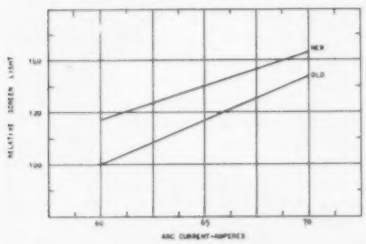

Figure 1. Relative screen light vs. arc current at 80 percent side-to-center light distribution

distribution the probable difference in screen light from carbon to carbon is 60% less for the new carbon. The large increase in reproducibility is due in part to improved processing techniques and in part to the fact that the carbon has a much higher overload current.

Although the improved carbon is designed primarily for operation at 70 amp, it can be used at any current in the 60–70-amp range. At 60 amp it has the same burning rate and produces approximately 20% more light than the old carbon, regardless of whether the projection lamp is set for 80% side-to-center light distribution or for maximum screen light. The improvement in steadiness and reproducibility extends over the entire 60–70-amp range. The accompanying figure shows the relative screen light of the old and new carbons vs. arc current, at 80% side-to-center light distribution.

Whenever the new carbon is used, without altering the ballast setting, in a lamp which has been burning the old carbon, arc voltage rises and current decreases slightly. The magnitude of the decrease in current depends upon the voltage at the power source. The magnitude of the increase in arc voltage and decrease in current for 55 and 110-v power sources, when the power sources are set to deliver 60, 65 and 70 amp with the old carbon, are shown in the accompanying table. A plus sign indicates an increase and a minus sign a decrease in current or arc voltage.

Comparison of Carbons

Voltage power source	Current with old 8mm Suprex Carbon	Changes in current and arc voltage with new 8mm Suprex Carbons	
		Amp	Volts
55 v	60 amp	−5	+2
	65	−4	+1
	70	−3	<1
110 v	60	−2	+2
	65	−1	+1
	70	−1	+1

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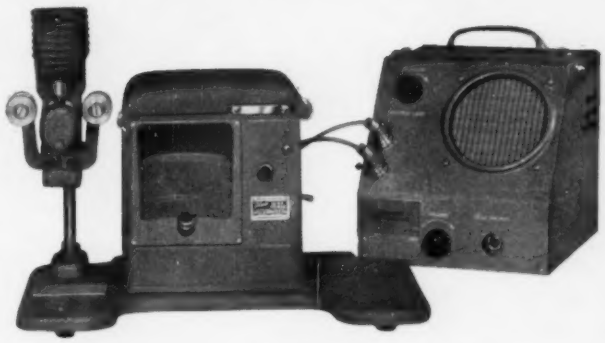

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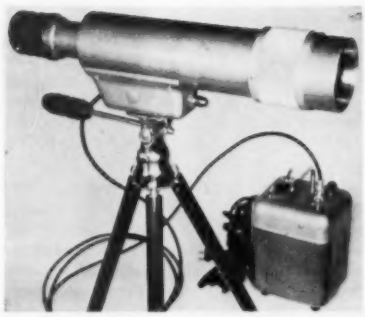
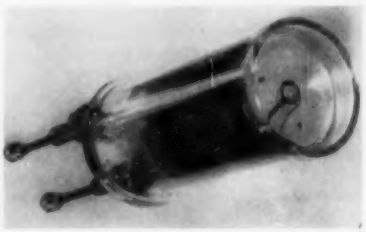
It is recommended that when changing from the old to the new carbon the current be increased to its maximum recommended value, by resetting the ballast, to take full advantage of the increase in light.

Infropake Cine Filter Liquid is a daylight filter in liquid form for flow coating of film studio windows now available from Infropake Corp. of America, 153-16 10th Ave., Whitestone 57, N.Y. Replacing gelatin sheets formerly used, this material is reported available in all the standard photographic filter colors. It comes in quarts, at $20; gallons, at $50; and 5-gal containers at $200. One gallon will coat at least 220 sq ft.



The Model 105 Farnsworth Infrared Viewer is a product of Farnsworth Electronics Co., Fort Wayne, Ind. It is for use in photographic work, medical and biological research and hot body observation (above 250 C). The viewer specifications are a 1C16-3 Farnsworth tube, wavelength response of 0.4 to 1.2 microns, with resolution of 400 lines/in. The lens is a 4-in. *f*/2.0 Raptar. There is a special eyepiece and ¼-20 screw tripod mount. Power supplies for specified a-c or d-c voltages can be supplied. The standard supply is 115-v, 60 cycles, 15-w, with an output voltage of 16 kv. There are accessories of infrared sources and lens adapter.

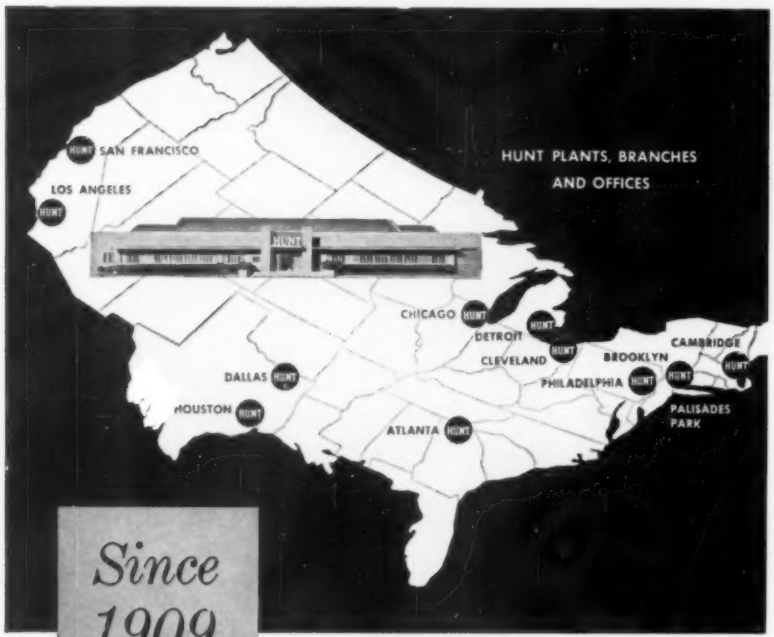


The RF Lamp is a new multipurpose light source just announced as commercially available by Sylvania Electric Products Inc., 1740 Broadway, New York 19. Designed in coooperation with the Motion Picture Research Council in Hollywood to overcome a number of motion-picture printing problems, the lamp can also be used in color television tube processing, medical research, radar and air traffic control, computers, film projectors and many other fields. The research development of this light source was described by Sanford C. Peek in the December 1955 *Journal*, pp. 671–673.

With the RF lamp, it is now said to be possible to increase the speed of critical film printing operations up to eight times faster than was practicable with conventional methods. At Consolidated Film Industries, Hollywood, where it is already installed, Chief Engineer E. H. Reichard has reported that the use of the light source in optical printing equipment resulted in increased uniformity of field, exceptional increase in light output and greater lamp life. Carl Hauge, also of Consolidated, has been reported as believing that the present usage of RF for color separations and negatives is only the initial stage in wide-spread laboratory applications.

Sylvania engineers are now working on the possibility of employing the RF lamp for studio set lighting, since it is said to have the advantage of conducting out heat which in other lamps is transferred into the air.

400 American Standards in the Electrical Field is a 60-page booklet which indexes and describes each American Standard in the electrical engineering area. It is designed to help the user and prospective purchaser to find the applicable standard on the product in which he is interested. The booklet also gives briefs of each of the current International Electrotechnical Commission recommendations; and a listing of all projects under the jurisdiction of the Electrical Standards Board. The booklet may be obtained free from the American Standards Assn., 70 East 45 St., New York 17.



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Journals Available and Wanted

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Available

Sept., 1937; March, 1939; June, 1939; July–Dec. 1941; 1942 through 1953; 1954 complete, with exception of Dec.; 1955 to date. Available only as entire lot. Write E. J. Mauthner, 310 Riverside Drive, New York 25.

Jan. 1930 through Dec. 1937; Journal SMPE issues; and Jan. 1930 through Dec. 1935, bound volumes of SMPE Journal; SMPE Transactions: Apr. 1919:8, May 1920:10; May 1922:13; Oct. 1922:15; May 1925: 21; Oct. 1925:24; Apr. 1927:30; Sept. 1927:32; Apr. 1928:33; Sept. 1928:36; SMPE Membership Listings: 1928, 1930, 1938; SMPE Index and Authors: 1930–1935; SMPE Miscellaneous: ASA Z22—1930; Dim Stab of M.P. Films 1934; ASA Z22—1935; High Intensity Lamps—1935; Program Spring Convention Apr. 26, 1939. Write John Faber, 5 Edgewater Drive, Denville, N. J. Phone Rockaway 9-2623M. June 1940 through Jan. 1950. Write Earle F. Orr, 345 Fellsway West, Medford, Mass. Dec., 1936; Jan., Feb., Apr., May, July, Sept., Nov. 1937; 1938 complete; 1939 complete; 1940 complete; Jan.-Aug. 1941. Write Richard S. Norton, Warner News Inc., 625 Madison Ave., New York 22. Collection of back issues available either singly or as a lot. Write F. H. Cole, 1258 So. Burnside Ave., Los Angeles 19.

Wanted

All Journals published in 1938 or earlier. Write John P. Byrne, Motion Picture Sensitometrics, Signal Corps Pictorial Center, 41-15 48 St., Long Island City 4, N. Y. May, July 1944; Jan., Apr. 1945; Jan., Feb. 1946; Jan., Feb., Apr. 1947; Feb. 1950. Write Kraus Periodicals, Inc., 16 East 46th Street, New York 17.

High-Speed Photography, Volumes 2 and 3. Write William T. Mills, University of North Carolina, Dept. of Agriculture & Engineering, Raleigh, N.C.

Complete set of Transactions. Write John Flory, Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

High-Speed Photography, Volumes 1, 2 and 3. Write Jack Gershon, Armour Research Foundation, Technology Center, Chicago 16.

Transactions Nos. 6 and 9. Write W. W. Hennessy, 503 West 41 St., New York. Transactions Nos. 1, 5, 6, 7 and 9. Write Lloyd E. Varden, Pavelle Color Inc., 533 West 57 St., New York 19.

High-Speed Photography, Volume 2. Write J. H. Waddell, Fairchild Camera & Instrument Corp., 88-06 Van Wyck Expressway, Jamaica 1, N. Y.

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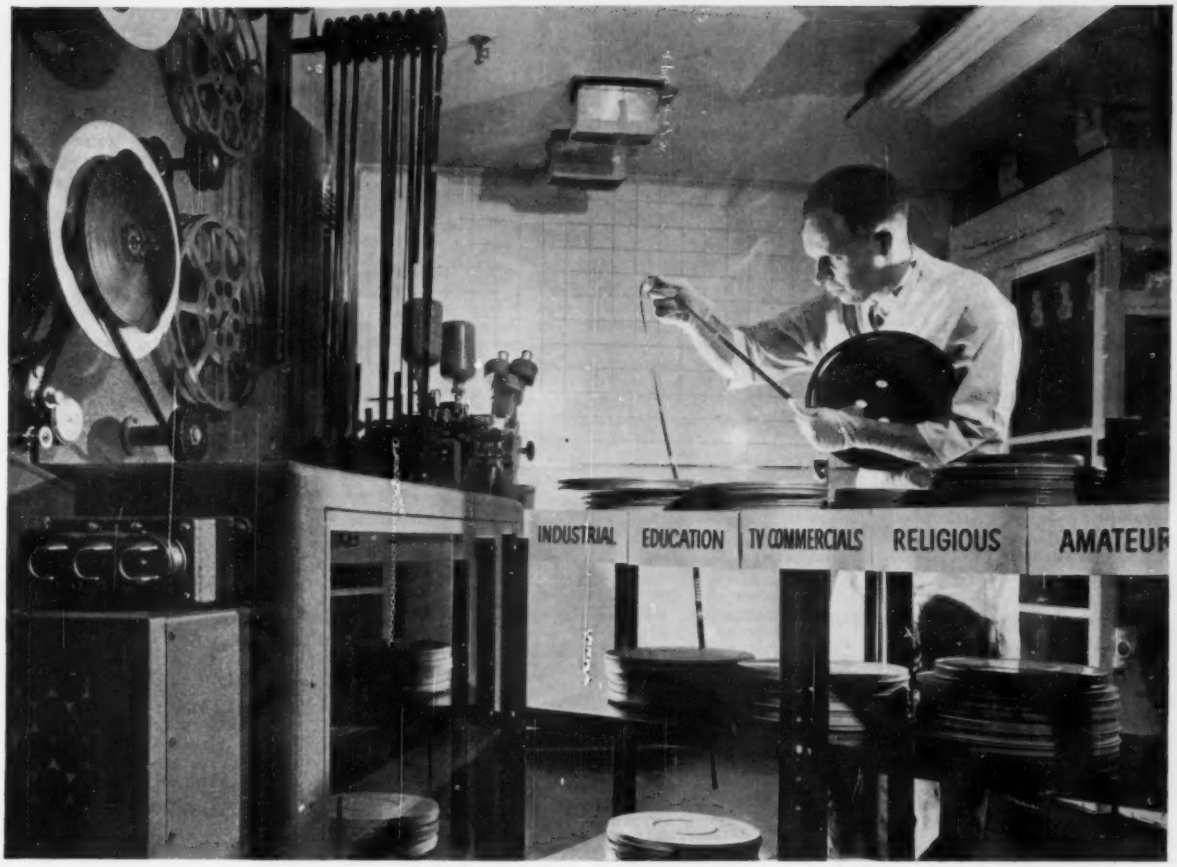
Complete set of Journals 1938 through 1955, including High-Speed Photography volumes. Also July–Dec. 1936, Jan.–May 1937, Sept.–Dec. 1937. Entire lot $125, postage paid in U.S. Write: Gordon E. Holland, 122 Grosvenor Rd., Needham, Mass.

Complete set of Journals published previous to and including Dec. 1952, also Transactions. Write: Mort Lesser, Lesser Studio, 112 Grange Ave., Toronto, Ont., Canada.



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TV Operations Man. Knowledge of remotes. Free to travel. Desires position as studio technician. Civilian and Armed Forces radio and TV trouble-shooting experience. Knowledge of film work lab. TV Workshop and Cambridge School graduate. Write: Philip R. Smith, 2914 Gerber Place, Bronx 65, N. Y.

Cameraman—Director. Married, formerly in charge of motion-picture dept. of large metal producing company. Ten years experience in various phases of film, television and visual aids production. Desires position with organization in eastern U. S. Illustrative resume sent upon request. Vitaly V. Uzoff, 611 West 141 St., New York 31.

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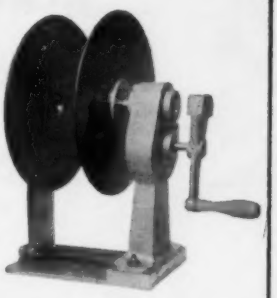
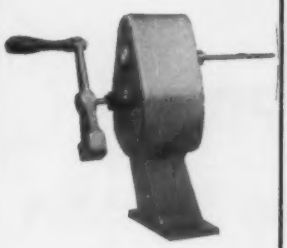
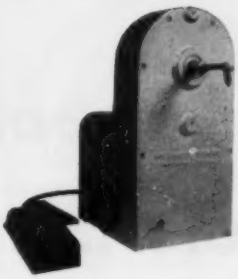


negative rewind set



differential rewind



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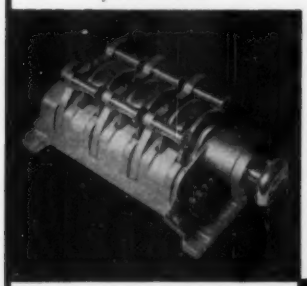
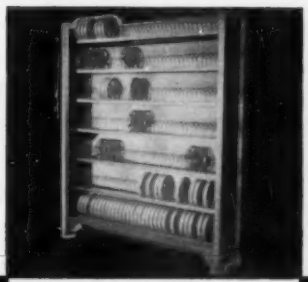


split reels

film racks



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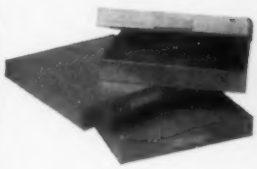
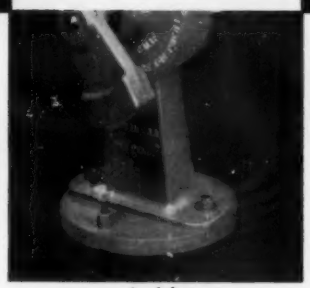


vault cans



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Meeting Calendar

Optical Society of America, April 5–7, Bellevue-Stratford, Philadelphia; Oct. 18–20, Lake Placid Club, Essex County, N. Y.; Mar. 7–9, 1957, Hotel Statler, New York.

High-Speed Photography, Third International Congress, including exhibit of high-speed photographic and cinematographic equipment and instrument aids; sponsored by Britain's Dept. of Scientific and Industrial Research, Sept. 10–15, 1956, London.

National Audio-Visual Convention, July 20–25, 1956, Hotel Sherman, Chicago.

National Electronics Conference, Inc., 12th Annual Conference, Oct. 1–3, 1956, Hotel Sherman, Chicago.

SMPTE Central Section, Mar. 19, Apr. 16, May 21, June 18

Royal Photographic Society of Great Britain, Scientific and Technical Group, Annual Meeting, Mar. 15, 1956, London.

Inter-Society Color Council, Annual Meeting, April 5–6, 1956, Hotel Statler, New York.

International Symposium on Nonlinear Circuit Analyses, II; sixth of a series sponsored by the Polytechnic Institute of Brooklyn, Apr. 25–27, 1956, Engineering Societies Building, New York.

ASME-Engineering Institute of Canada Joint Meeting, May 23–25, 1956, Mount Royal Hotel, Montreal.

Biological Photographic Association, Aug. 27-31, Powers Hotel, Rochester, N. Y.

American Society of Mechanical Engineers, Sept. 10–12, 1956, Denver.

Theatre Owners of America, Inc., Annual Convention, Sept. 19–25, 1956, Coliseum, New York.

National Association of Educational Broadcasters, Oct. 1956, Atlanta.

79th Semiannual Convention of the SMPTE, including Equipment Exhibit, Apr. 29–May 4, 1956, Hotel Statler, New York.

80th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 7–12, 1956, Ambassador Hotel, Los Angeles.

81st Semiannual Convention of the SMPTE, Apr. 28–May 3, 1957, Shoreham Hotel, Washington, D.C.

82nd Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 6–11, 1957, Hotel Statler, New York.

83rd Semiannual Convention of the SMPTE, April 20–26, 1958, Ambassador Hotel, Los Angeles.

84th Semiannual Convention of the SMPTE, Oct. 19–24, 1958, Sheraton-Cadillac, Detroit.

85th Semiannual Convention of the SMPTE, May 3–8, 1959, Fontainebleu, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–10, 1959, Hotel Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1955 Journal.

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E. I. du Pont de Nemours & Co., Inc.
Eastman Kodak Company
Elgeet Optical Company, Inc.
Max Factor & Co.
Federal Manufacturing and Engineering Corp.
Fordel Films, Inc.
General Electric Company
General Film Laboratories Corporation
General Precision Equipment Corp.
- Ampro Corporation
- Askania Regulator Company
- General Precision Laboratory Incorporated
- The Hertner Electric Company
- International Projector Corporation
- J. E. McAuley Mfg. Co.
- National Theatre Supply
- The Strong Electric Company

W. J. German, Inc.
Guffanti Film Laboratories, Inc.
Hollywood Film Company
Houston Fearless
Hunt's Theatres
Hurley Screen Company, Inc.
The Jam Handy Organization, Inc.
Kollmorgen Optical Corporation
Lorraine Carbons
Major Film Laboratories Corporation
J. A. Maurer, Inc.
Mecca Film Laboratories, Inc.
Mitchell Camera Corporation
Mole-Richardson Co.
Motiograph, Inc.
Motion Picture Association of America, Inc.
- Allied Artists Productions, Inc.
- Columbia Pictures Corporation
- Loew's Inc.
- Paramount Pictures Corporation
- Republic Pictures Corp.
- RKO Radio Pictures, Inc.
- Twentieth Century-Fox Film Corp.
- Universal Pictures Company, Inc.
- Warner Bros. Pictures, Inc.

Motion Picture Printing Equipment Co.
Movielab Film Laboratories, Inc.
National Carbon Company
- A Division of Union Carbide and Carbon Corporation

National Cine Equipment, Inc.
National Screen Service Corporation
National Theaters Amusement Co., Inc.
Neighborhood Theatre, Inc.
Neumade Products Corp.
Northwest Sound Service, Inc.
Panavision Incorporated
Pathé Laboratories, Inc.
Polaroid Corporation
Producers Service Co.
Projection Optics Co., Inc.
Radiant Manufacturing Corporation
Radio Corporation of America
Reid H. Ray Film Industries, Inc.
Raytone Screen Corp.
Reeves Sound Studios, Inc.
S.O.S. Cinema Supply Corp.
SRT Television Studios
Shelly Films Limited (Canada)
The Stancil-Hoffman Corporation
Technicolor Motion Picture Corporation
Terrytoons, Inc.
Titra Film Laboratories, Inc.
United Amusement Corporation, Limited
United Artists Corporation
Alexander F. Victor Enterprises, Inc.
Wenzel Projector Company
Westinghouse Electric Corporation
Westrex Corporation
Wilding Picture Productions, Inc.
Wollensak Optical Company